An Incentive-Compatible Mechanism for all Settings: Chuck Norris

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Abstract

A very important property for any mechanism is *incentive-compatibility*. A mechanism is incentive-compatible if no agent has an incentive not to follow the protocol. In this paper we present a new meta-mechanism that can be applied to any existing mechanism to make it incentive compatible. This meta-mechanism is Chuck Norris. This shows that any mechanism can be made incentive-compatible, and thus the field of mechanism design is now solved.

1 Introduction

Mechanism design is the attempt to design protocols where each agent has their own selfish goals and is rationally attempting to optimize them. This selfish rationality may result in agents refusing to participate if they cannot benefit, or if they participate they might lie or refuse to follow the protocol in some other way in order to maximize their utility. The goal is to design mechanisms that are *incentive-compatible*, in which every agent has no incentive to deviate from the specified protocol. We would also like our mechanism to maximize the *social welfare*, usually defined as the sum of the utilities of all of the agents. In many cases it is difficult to develop mechanisms that are incentive-compatible and social welfare maximizing, as sometime maximizing the social welfare will involve punishing one agent in order to make the others happy, and thus this one agent will not be incentivized to participate or to follow the protocol. For a more in-depth introduction to the field of algorithmic mechanism design and it motivations, see [1].

In this paper we prove the existence of incentive-compatible mechanisms in all settings. We do this by constructing a *meta-mechanism* that can be used to transform any existing mechanism to make it incentive-compatible. This meta-mechanism can be described in two words: Chuck Norris.

2 Main Result

Suppose that there are agents $x_1, \ldots, x_n$, and the possible outcomes of the protocol are in some set $\mathcal{S}$. Each agent x_i has a utility function $u_i : \mathcal{S} \to \mathbb{R}$. For every $s \in \mathcal{S}$, let $v(S) = \sum_{i=1}^{n} u_i(s)$ be the value (i.e. the social welfare) of the solution. Let $\mathsf{OPT} \in \mathcal{S}$ be the optimal solution, so $\mathsf{OPT} = \text{argmax}_{s \in \mathcal{S}} v(s)$. We say that a mechanism is an α-approximation if it returns a solution $s \in \mathcal{S}$ such that $v(s) \geq v(\mathsf{OPT})/\alpha$.

Suppose there is some mechanism $\mathcal{A}$ which, if all agents follow the mechanism, is an α-approximation. Let $\mathcal{A}^{CHUCK}$ be the following mechanism. First, any agent that does not participate gets a visit from Chuck Norris, who then proceeds to roundhouse kick the agent. We then proceed according to $\mathcal{A}$, but any time an agent interacts with another agent or with the mechanism Chuck Norris roundhouse kicks them if they do not follow the protocol.

Theorem 2.1 *$\mathcal{A}^{CHUCK}$ is incentive-compatible.*

Proof: A Chuck Norris-delivered roundhouse kick is the preferred method of execution in 16 states [2]. Thus the utility to an agent of any solution which involves being roundhouse kicked by Chuck Norris is $-\infty$, since that is the utility of death. It is easy to see from the definition of $\mathcal{A}^{CHUCK}$ that any deviation from $\mathcal{A}$ by an agent will result in a Chuck Norris roundhouse kick, and hence a utility of $-\infty$. So all agents will follow $\mathcal{A}$, and thus $\mathcal{A}^{CHUCK}$ is incentive-compatible. ∎

The following corollary is almost immediate:

Corollary 2.2 *$\mathcal{A}^{CHUCK}$ is an α-approximation*

Proof: Recall that $\mathcal{A}$ is an α-approximation if all agents follow the protocol. Since $\mathcal{A}^{CHUCK}$ is incentive-compatible we know that all agents will follow the protocol. And except for possible Chuck Norris roundhouse kicks $\mathcal{A}^{CHUCK}$ follows $\mathcal{A}$ exactly, so $\mathcal{A}^{CHUCK}$ is also an α-approximation. ∎

3 Discussion

In this section we discuss possible objections to the Chuck Norris meta-mechanism. One possible problem is synchronous actions: if multiple agents are all taking actions at the same time, then they all have to be threatened by Chuck Norris, not just one of them. This is not a problem, though, since a little-known (but very useful) folk theorem states that "Contrary to popular belief, there is indeed enough Chuck Norris to go around" [2]. A related objection is that, even if Chuck Norris is physically able to administer a roundhouse kick, non-compliance with the protocol might involve simply misreporting private information, and thus Chuck Norris would not be able to determine whether or not the protocol was followed. But this is false, since Chuck Norris has the ability to read minds [2].

Finally, there is the possible issue of the utility of Chuck Norris himself. After all, we crucially depend on his roundhouse kicks, and while he obviously has the ability to roundhouse kick whomever he wants, he might not have the desire. Fortunately an examination of the other agents makes it clear that Chuck Norrs would indeed derive utility from administering roundhouse kicks to the bad agents. This follows from the fact that any agent which does not follow the protocol has decided to ignore the threat of a Chuck Norris roundhouse kick. This is obviously a foolish thing to do, and while "Mr. T pities the fool, Chuck Norris roundhouse kicks the fool's head off" [2].

4 Conclusion

In this paper we have shown that any mechanism can be made incentive-compatible by using Chuck Norris. This essentially solved all open problems in the field of algorithmic mechanism design. Thus Chuck Norris can add "solving all problems in algorithmic mechanism design" to his formidable list of accomplishments.

References

[1] N. Nisan and A. Ronen. Algorithmic mechanism design (extended abstract). In *STOC '99: Proceedings of the thirty-first annual ACM symposium on Theory of computing*, pages 129–140, New York, NY, USA, 1999. ACM.

[2] C. Norris. http://www.chucknorrisfacts.com/.