Franco and the Agents' Hell

A scenario of worst-practices in agent-based software engineering.

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The Scenario

It was a pleasant, warm, evening.

Franco walked slowly inside the park, found a nice area of soft grass, and sat down. Got a packed ball of spaghetti out of his left pocket, and an open beer out of the right. He ate and drunk, and rested quietly in front of a wonderful and clean spring sunset, rare to be seen in such a smoggy town. It wasn't the night to spend by the Salvation Army, he though; and as the dark started arriving, he lay down looking for Venus to appear.

"Please stand up and report to the nearest police station. City laws forbid beggars and homeless to rest in the park at night". He suddenly get up, surprised by the authorative synthetic voice of the park control system, and saw one of those irritating all-the-same-looking young yuppies, looking for a place to hide with his girlfriend. As any other boy of his age and social extraction were doing that year, he was wearing an old pair of Timberland shoes, carefully dirtied so as to appear as poor as possible. Stylists and look designers are strange, he thought.

It wasn't strange, instead, that the mayor still didn't find the money to organize the removing all the millions of software agents dispersed in every corner of the town. They were ridiculous sometimes, and highly disturbing, as in those cases they confused a rich good-looking boy for a homeless, just because of his shoes. Franco didn't care too much. He, as any true beggar, knew exactly how to cheat those software agents, and how to break local laws without any disturb from them, e.g., by simply re-organizing a bit his dressing.

The young boy got annoyed, stood up, and walked out of the park hand in hand with his girlfriend. The synthetic voice stopped yelling. Franco relaxed and watched the dark sky and the multitude of stars that already appeared. Then, as often happened in such lonely nights, started thinking at that last wonderful days of his life. The days right before his personal agents' hell.

It was about 20 years before, in the early 20's. He was spending the Saturday night in a disco together with his best friends. He just ordered a draft beer to a very nice waitress. Paolo did the same from his PDA at the same time, and everybody in the group was wondering which of the two beers would have arrived first. Franco won the bet: Paolo paid Franco's beer to the waitress, asked her another one for himself, then tried to discover from his PDA agent what in the world was the status of its electronic beer order. Unfortunately, the agent was stupidly smiling on the screen asking Paolo to be patient and able to say nothing more…. Nobody was using that way of ordering beer any longer, but it was always fun to bet on that peculiar competition. In the past months, however, the waitress systematically won over the agent, mainly due to the fact that E-marketplaces, that agents had to access to perform the payment transactions, was experiencing major computational-power reductions to meet reduced request.

At the same table, Andrea and Mario were talking about music. Mario was quite irritated by the fact that he bought the mp7 of the latest Anastacia's record at almost twice the price paid by Andrea a few hours before. Andrea and Franco joined that discussions – yet another occasion of

laughing about Paolo's PDA agent – and also discussed about the recent resolution of the EU commission of imposing a strong price regulation on E-marketplaces, with the aim of gradually eliminating dynamic pricing systems based on agent negotiations. Andrea and Paolo also claimed that they believed in the existence of a sort of secret society, capable of controlling the pricing system and of influencing it. However, everybody knew that that was simply a sort of urban legend, and that it was simply impossible to control the billions of agents negotiating in the network and the unbearable price fluctuations deriving from such negotiations. After some very hard and stimulating discussion, they all agreed on the usefulness of the EU commission decision.

Laughing, discussing, and drinking. It appeared like a very usual Saturday night, after all. However, that night was by no means a usual night for Franco. That night Franco was expecting someone that could have changed his life. And that changed it indeed, although in the exact opposite way he was expecting.

That night at the disco Franco had a date with Cecchetto, the most important music agent of the capital. He had to insist a lot to organize that meeting, and once he succeeded in contacting Cecchetto and he agreed in meeting him, Cecchetto postponed the meeting several times. Finally, that was the night. Franco was already a rather appreciated sax player, and he used to play as a soloist in major discos and pubs of the town. However, Cecchetto could have open up new doors to him: the capital theatres, mp7 records for sell in major portals, and why not the WebTV.

After having spent a few wonderful hours with his friends, he started seriously worrying. Cecchetto should have arrived at 11pm, and it was already midnight. At disco's closing time, he was rather angry. Not desperate though: Cecchetto was a very busy man, and he could have been involved in some unexpected affairs…"I will meet him another day", he thought…

During the next few weeks, he continuously tried in vain to contact Cecchetto, which seemed to deliberately ignore him. However, this is not the worst part of the story. Suddenly after that night at the disco, he received a lot of messages all on the same topics: "We are sorry that we have to cancel your exhibition". In a week, all his exhibitions were cancelled without apparent reasons, and no other theatre or pub accepted to host Franco's exhibitions: he was totally without work and without anybody in town willing to give him some.

What happened thereafter is known: Franco's life started getting worse and worse everyday, friends disappeared together with money, until all that was left to him was an old sax.

It took a while to him to understand what happened, and it could have been better for him not to know. Cecchetto was simply late that night, and sent a personal message to Franco to apologize: "Franco, I am late. Please wait me: I want you sax!". Somehow, Cecchetto's agent misunderstood the last vowel of the message, interpreting as an "e". Franco's agents, by its side, had been properly instructed to automatically answer to sexually-related spam messages, before deleting them, with sentences like: "You bastard! Stop make me lose my time!". Being a very powerful and susceptible man, it took nothing to Cecchetto to have every door in the nation closed to Franco and to his sax.

Franco tried to explain the story to the rest of the world, but it was too late. To all persons hearing to him, such a story simply represented another interesting example to advocate the need of dismissing software agent technologies, a decision that the EU commission took a few years later.

6am, the night passed, and the feeble light of the morning started illuminating the highest leaves of the trees in the park. A young policeman arrived, and kindly asked Franco to wake up and, please, notify the nearest police station the next time he will be in the need for a place to sleep. "Please stand up and report to the nearest police station. City laws forbid beggars and homeless to rest in the park at night". The policeman stood. Franco looked into his eyes, and then down to his feet, implicitly inviting him to do the same. They loudly laugh together. The policeman was wearing a pair of that stupid, dirt, Timberland shoes.

Discussion

The notable advances in miniaturizations and communications technology, together with the recent advances in artificial intelligence and agent-based computing, let us envision a world in which computer-based and artificial intelligence technologies will be pervasive. Everything, our cities, our homes, our dresses, will be augmented with a multitude of inter-connected computer-based systems, each hosting one or more software agents, devoted to monitor the surrounding world, and delegated to automatically perform activities on our behalf.

From heaven…

As is may have been better depicted by other scenarios, it is very likely that such hardware technologies, properly empowered with agent-based software technologies, will dramatically improve our quality of life. For instance, w.r.t. the above-delineated scenario:

- In a city, automatic intelligent control-system can be integrated in the streets and public sites of our cities, to monitor weather and traffic conditions, to provide us with useful information, and to improve the safety of our cities. In a park, for instance, a set of embedded sensors controlled by intelligent software agents can recognize when something wrong or illegal is taking place, can discourage law-breakers, and can alert the nearest police station.
- In our homes and offices, as well as in discos and pubs, sensors and computer-based systems in our domestic hardware and in our walls, ruled by a multiplicity of distributed software agents can provide for automatic heating regulation, can automatically order by the nearest store what's missing in the kitchen, can automatically answer to phone calls and forward us important phone calls.
- In our dresses, a multiplicity of devices inter-operating via short-range wireless technologies, can provide to coordinate the activity of wristwatches, PDAs, cellular phones, augmented reality glasses, can provide to store SMS messages in the PDA, automatically answer them and regulate the exact time of our wristwatches. Also, by connecting to the computer-based infrastructure in the city, can let us visualize the presence of environmental dangers in our augmented reality glasses that, at their turn, can store such precious information in the PDA.
- Agent-based marketplaces will be the place where most commercial transactions occur, accordingly to mechanisms and dynamic pricing systems (e.g., auction-based), suitable for a dynamic economy and that we, as humans, would have not time and promptness to afford.

…To Hell

Of course, it is our hope that the above technological "heaven" will soon become a reality. However, our scenario aims at pointing out the attention to the fact that such paradise, due to the lack of enough engineering foundations and discipline, could also become a hell, and would make us refuse the use of such technology. For instance, in the scenario:

- The agents in the park-control system have learned, during years, to recognize a beggar from its shoes. However, as the new trend of rich boys wearing poor shoes has taken place, the agents are not enough reactive in re-adapting their behaviour, so that a rich boy is forced to go out of the park not to be disturbed. Conversely, Franco and the other beggars have already learned how to cheat the agents, so as not to be recognized as beggars. Even if the agents can, with time, re-adapt to the changed situation, they are likely to be useless for a long time, and even disturbing.
- Of course, for such a useless system, de-activation is one solution. However, is it possible (or simply economically feasible) to remove millions of computer-based systems dispersed in a city? Otherwise, is it be possible to de-activate such system, typically self-powered, and the always-executing agents there resident? To avoid de-activation, is it possible to globally re-

program millions of agents at a time, so as to force adaptation to the new situation? In the scenario, it appears like the Mayor has simply decided to ignore such situation despite the EU resolution. Not to mention the pollution problems associated with such pervasiveness…

- The fact that agents can be delegated to do work on our behalf does not necessarily imply that they such work can be done better. In the scenario, the beer order performed via the Paolo's PDA agent stuck in some commercial transaction in the network, while the waitress simply had to take a beer off the fridge and give it to Franco. As an additional note, are we sure that we really want certain types of activities to be delegated? Why should Franco not be given the pleasure of talking with a nice waitress receiving both a beer and a smile in return?
- Agent-based marketplaces and dynamic pricing systems may dramatically further increase the already high dynamics – and hardly sustainable – of commercial processes. Besides political opinions related to the opportunity of such dynamism, and by restricting our focus to more technological questions, the real problem of having specific "critical" factors of a societies (such as the prices of goods) to an artificial society of agents may dramatically increases instability. Instability and chaotic behaviour are already a characteristics of today's market economies, and it has been often claimed that – in an agent-mediated economy – the rigid rationality of software agents may provide for more stable equilibrium and for more predicting behaviour. However, such a claim is currently hardly justified by the lack of experience and realistic simulations, and does not take into account that the rationality of a component has nothing to do with the possible chaotic and unpredictable behaviours that can emerge in a collective. In the scenario, the price changes in music files that Mario and Andrea have experienced can have emerged from the global agent-based economy having reach a strange – possibly chaotic – attractor, despite any actual change in the request for such types of goods.
- More in general, multitudes of interacting autonomous components executing in a dynamic environment defines an interactive system whose global state evolves more as a function of environmental dynamics and interactions than as a function of internal components intelligence and rationality. Therefore, as software agents will start populating our everyday's networks and environments, the emergence of such global behaviours will play a major role in all of our activities in which agents will be somehow delegated to play a role. Unfortunately, the state of the art in complexity science if far from giving any constructive methods for controlling global states in such interactive systems. Of course, for agents to be accepted and not banned by the society, as it they were devil entities controlled by an esoteric secret society, such situations must be somehow prevented.
- Delegating work to agents requires us to strongly trust our agents. Still, human decisional capability – as required in a large amount of works – will be hardly approached by software agents. In the scenario, we have described a possibly naive and extreme example of how the lack of this capability in Franco's message agent (having misinterpreted Cecchetto's message) have totally destroyed Franco's existence, and simply because Franco fully trusted on his agent to automatically answer spam messages. Even by considering much more intelligent agents, it will always possible to find similar examples. Here, we do not intend to say that trusting agents is and will be always wrong. Rather, we are saying that trust can and have to come gradually, and that the potential advantages of software agents have to be carefully evaluated against its potential drawbacks. The risk we envision is that consumers' enthusiasm and software developers' urge of selling advanced technologies – which is already characterising the software market, and which is leading to products of increasingly low quality – will make everybody forget the potential risk of such a powerful technology. Agents will have to be developed and deployed not the same way big software monopolies actually deploy badly tested and undocumented packages but, instead, based on exhaustive tests documenting the characteristics and limitation of the deployed agents, their learning processes (if any), the impact of environmental dynamics and uncertainty on agents' behaviours, all these being documented by extensive "manuals".

The Agenda

Our "Agents' Hell" scenario aims at emphasizing that there is not only the need to explore methods to make agents more and more intelligent and autonomous and to analyse how and to which extent agents can be delegated to perform work on our behalf. In fact, there is also the need of advancing the discipline related to the engineering of such systems, and by giving such discipline the role of not only enthusiastically advertise the advances of agent-based technologies, but also of and studying the limitations and dangers possibly associated with it, and of overcoming it whenever possible.
To this end, a number of agent-oriented software engineering researches can be sketched in that direction:

- Study and understand the social, political, and ecological implications of having billions of agents executing in our physical environments, interacting with each other and with the environment in a globally interconnected network, and possibly able to monitor our everyday activities. Any analyst, prior to start developing any software system, must have very clear in mind whether the system is feasible and what will be its impact. Such considerations are very important for agent-based systems, due to their pervasiveness and to the criticality of the works they will be devoted to.
- Study and model the relationships of the agent system with the environment. The environmental conditions will change, while we will not be necessarily given the possibility to update our agent-based system to any change in the environmental conditions. So, our system should not only work and be able to learn, it must be able to be adaptive to environmental changes and be responsive enough to them.
- Define well-founded modelling tools and methodologies to help developing and maintain well-engineered agent systems, capable of executing predictable behaviours in the presence of a large number of interacting agents, and enabling some sort of control to make them easily maintainable, despite the impossibility of controlling each single agent and the environmental dynamics. It is our feeling that, because of both the large size of agent systems and their being so strictly tight to the physical world, such methodologies and tools should take inspiration, other than from the logical science (as it has been traditionally in the computer science area), also from the science of complexity and, more general, from all those scientific disciplines dealing with complex macro systems (i.e., physics, biology, and sociology).
- Study the scalability properties of multi-agent systems well before largeness problems arise. In fact, since the moment a few agents will start populating the world, new systems and new agents will added every years, eventually ending up with systems of dramatic size. At that time, however, it will be too late both to re-think at our methodologies, possibly conceived for systems with a only few dozen of agents, and to stop the multitude of agents already executing accordingly to models unsuitable to the enlarged size.
- Study and define new performance model, specifically tuned to agent-based systems. Such models should do more than integrate and extend well-assessed performance models for distributed systems (indeed needed) but also define models of performances for "trust", able to characterise how and to which extent an agent system can be trusted for a given activity.
- Strongly promote, more than ever, the adoption of rigorous software engineering process, and the associated documentation, test, and maintenance activities.

In addition to the above topics, explicitly emerged from discussion at the meetings of the "Methodologies and Software Engineering for Agent Systems" SIG of Agentlink, any other research topics headed toward giving discipline to agent-oriented software development will be useful for making our future an "agents' heaven" rather than an "agents' hell".

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