



Forge ahead

At Ubisoft, the **greatest minds in AI** dream of a future in which videogames are smart enough to solve real-world problems

There was a time, not so long ago, when it was fashionable to accuse Ubisoft of repeatedly making the same thing. In fairness, Ubi looked worryingly comfortable. Most of its games rarely deviated from a set formula: whether it was *Assassin's Creed*, *Far Cry*, *Watch Dogs* or *The Division*, everything seemed to blend into one analogous soup of one-button takedowns, X-ray vision, climbable towers and collectibles. They say that good design is invisible; Ubisoft's more

significant achievements in videogame design over the past several years have, perhaps, gone under the radar. Until now, that is. The annual Ubisoft Developers Conference brings together the company's various creative teams from all over the world to its Montreal studio for four days, an opportunity to share best practices and technological breakthroughs with each other in the hope of sparking new ideas. For the first time in eight years, the internal

conference officially opened its doors to press this year (while **Edge** has previously attended UDC, a strict NDA has ensured the details of Ubisoft's inner workings have stayed under wraps). It was an invitation to sit in on dev-focused talks and roundtables, where Ubisoft's best and brightest happily discussed trade secrets and huge advancements. A bold move, but one that makes sense in the Ubisoft narrative, reflecting the publisher's renewed focus on

Machine learning sees computer systems use big data to perform and improve certain tasks – without ever having been explicitly programmed to do so

HUMAN AFTER ALL
As AI becomes more advanced, and Ubisoft's virtual worlds become ever-more realistic, games could help solve real physics-based problems. "In videogames, we tend to imitate what's been done in the real world with motion capture," Yves Jacquier says. "We think for the first time – it's not old, it's only been two years since we've seen these kinds of concepts emerging – it goes around both ways." Highly developed AI in games could provide a useful virtual testing ground for medical and engineering products before they're prototyped, such as testing the effectiveness of a prosthetic limb in various situations: when the user runs, goes downstairs, gets into a car or falls. "Or how would a car behave in this or that situation – with pedestrians involved, or with weather conditions?" Jacquier says. "These are tests you cannot do in real life. Some of them would be so expensive it wouldn't work, and some of them are just not legal, or even moral! But in a videogame environment, you can do that."

transparency and outward communication in the last few years. *Watch Dogs* and *Assassin's Creed Syndicate* attracted ire from players. Ubisoft listened – but crucially, showed that it was listening. *Watch Dogs* returned for a sequel, minus the new-generation pressure and with a playful new attitude; *Assassin's Creed* took a very public year off to let Ubi take stock of the series, a well-received promise delivered upon with *Origins*. If there was a message, the message was undoubtedly: "We'll show you."

And if anyone continued to doubt that Ubisoft isn't out to change things, sitting in on UDC's in-depth lectures would easily quash them. In a hall filled with eager employees, the people behind *Assassin's Creed* quizzed those making *For Honor* and *Far Cry* about their latest advancements. Artificial intelligence was a topic discussed in detail at this year's UDC: to anyone looking closely at its recent games, Ubisoft's singular approach to AI is self-evident. It often goes beyond merely having enemies shoot guns or take cover, instead aiming to create realistic worlds with systems and AI that combine in interesting ways. Think, for example, how *Watch Dogs 2*'s San Franciscans are programmed to commit crime and call the cops on one another – or how *Origins*' guards need to take bathroom breaks, grab a bite to eat somewhere nearby or locate an unoccupied bed in the vicinity for a short kip.

UDC proved that Ubisoft's developers are out to build ecosystems that can function convincingly at all times, even when unseen. Their ideal worlds are the anti-Truman Show, essentially: the player is not the centre of it, although they can influence it, and the world must react appropriately when they do. Enter *Origins*' character-avoidance system, Pilot, and 3D volumetric solution, NavVolumes, which started to take shape behind the scenes of the original *Watch Dogs*. The navigation system ensures NPCs can realistically navigate both dynamic indoor and outdoor environments, and avoid colliding with

the player and other characters in a subtler manner that better mimics real human behaviour. It was followed by explanations of the breakthrough that made this superior pathfinding performance a reality: a simple, smart method of filtering out certain voxels near walls to reduce the memory footprint of the 3D data.

A talk about *Far Cry 5*'s AI, meanwhile, showcased not just how NPCs behave, but why. Devs explained that they program the 'guns for hire' according to their own version of Maslow's hierarchy of needs, with autonomy and convincing reactivity supporting systemic gameplay at the bottom of the pyramid, and contextual behaviours and purpose at the top. The idea is that the AI has a sense of self-preservation motivated by their individual agenda – grabbing a burger and a beer at the bar at the end of the day, or going fishing to bring home a catch for their family dinner – which makes their behaviour more believable. If they're wounded, they'll position themselves behind nearby cover and call for help; if an enemy sees their friends fall, their morale level will drop, and instead of acting as the player's punchbag, they'll do what any self-serving human would do: flee. It's clear that Ubisoft is making progress towards creating artificial intelligence that is more human, believable and self-sustaining than ever before. It doesn't come as a total surprise, then, when plenty of UDC discussions revolve around how the studio's machine-learning advancements are becoming developed enough to help build videogames themselves.

A new type of self-learning AI in *For Honor*, for example, is helping identify bugs and balance new weapons. With the third-person fighting game containing 18 heroes and 153 unique matchups, automated testing will soon be able to lift a huge weight from the dev team's shoulders: reinforcement-learning

algorithms have deep-learning AI bots train themselves en masse against each other, producing valuable data. While it's not yet perfected – deterministic behaviour tends to pop up, including the AI refusing to kill its opponent and instead repeatedly breaking its guard to game the algorithm for the most reward – it's close. The team even hopes to eventually include the DeepBots in-game: lifelike AI would mean opposition that could be tailored to players' individual playstyles, the ability to help balance an ever-changing meta and even sub in for online rage-quitters so adeptly that you may not even notice the switch.

A clutch of game releases later, and Ubisoft has realised that the more human AI becomes, the more applicable it is to real-world problems. To that end, it has founded La Forge – a small, whiteboard-covered prototyping space in the Montreal studio, home to some of the most advanced industry and academic

minds and dedicated to bridging the gap between the two worlds. "The concept of La Forge emerged from trials and errors – it did not happen overnight," says Yves Jacquier, executive producer of Ubisoft's production-services studio and La Forge project head. "We used to work with

universities, and created one of the first videogame AI chairs with Yoshua Bengio back in 2011. And what we learned was that we had many things we wanted to do together, but did not spend enough time focusing on how to be better at working on the same ground."

In the end, Jacquier knew he needed something as concrete as the in-house La Forge to make it work. It was a bet that he hoped would pay off. "You're telling the academic side, 'Come and work on-site in an industry', so it goes against the DNA of creating knowledge. And you're telling the industry, 'You will open all your doors to students and professors while they are in the building'. For a company like Ubisoft, that's

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Yves Jacquier personifies La Forge's academia/industry combination: he has a PhD in particle physics, and was part of the team that discovered the Higgs boson



ELECTRIC SWEEP
One UDC talk, given by Daniel Holden, animation researcher at La Forge, covered the benefits of using neural networks to help clean up motion-capture data in games. Train a neural network to learn how to map markers to points on an animation model, and you can effectively skip the laborious part of the process – fixing data problems caused by erroneous, corrupt or obscured markers – and go straight to the solving stage. This ‘robust solving’ solution compares the mo-capped model to a second, more accurate AI skeleton that’s learned correct movement through a huge amount of data. Then, it computes the differences and updates the skeletons to eliminate the errors, creating a result very similar to a hand-cleaned product. While there are limitations in the amount of training motion data currently available, and there’s still a little way to go before the software will be able to be used on Ubisoft’s games, Holden and co are making swift progress towards saving countless hours of developers’ valuable time.

dealing with some sort of secrecy in terms of brands and gaming, it’s a hard sell.” Jacquier laughs as he recalls his boss’ reaction to the pitch: “He told me in French, ‘C’est gonflé’. It’s ballsy!”

But the benefits for various aspects of the studio outweighed the costs, Jacquier argued. “When you have senior people making multiple games, maybe they want time to test a new idea. So that was a way to say, ‘Even if it doesn’t totally work as an acceleration innovator, maybe it can help retention, to attract people and also have a corporate impact. The more we support the university, the more people we can hire, and the more people can stay here in Montreal instead of going to the US. It’s good for the whole ecosystem.” Curious creators from among Ubisoft’s employees participate in three-month projects with post-grad students and scholars, bridging the gap between the academic world and the videogame industry to try to spark ideas that could have real-world applications. Imagine, for instance, AI so advanced it could create games in much the same way that a real human developer might.

The reality is closer than you might think. McGill University associate professor **Derek Nowrouzezahrai** demonstrates, during a remarkable UDC session, the ways in which machine learning can be used to generate realistic interactive graphics under massive time, and financial, constraints. “[At La Forge] we can leverage not only Ubisoft’s strengths in domain knowledge, and expertise in the people we have around us, but also their ability and decades of experience generating this realistic simulation data,” he explains. With years and years of data available on lighting effects, animations and physics, La Forge’s talented academics can teach AI to synthesise realistic behaviour without having to force their way through actual physics. Lighting that responds to changes in scenery can be auto-generated; a highly accurate representation of a human figure walking across uneven terrain is produced with algorithms instead of via the lengthy and expensive process of motion capture.



AI was one of two hot topics at this year’s GDC. The second, unsurprisingly, was live games – although discussions of how to reduce team fatigue led back to machine learning and automated dev processes

While the results aren’t up to Ubisoft’s usual big-budget, human-authored standards just yet, the studio is already making use of La Forge’s latest breakthrough. Commit Assistant, Jacquier says, is the “Minority Report of programming”: an AI software that can predict where bugs in developer’s code will appear before they even become a problem. Using the latest machine learning and big-data techniques, Commit Assistant combs through massive code repositories, analysing all past bugs and regressions and assigning a unique signature to each. When a dev submits new code, it’ll focus in on any matching signatures and warn of a possible bug.

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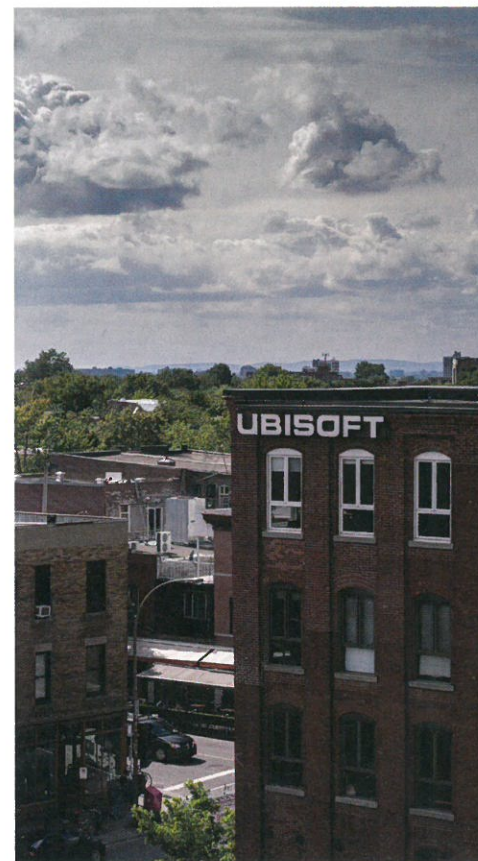
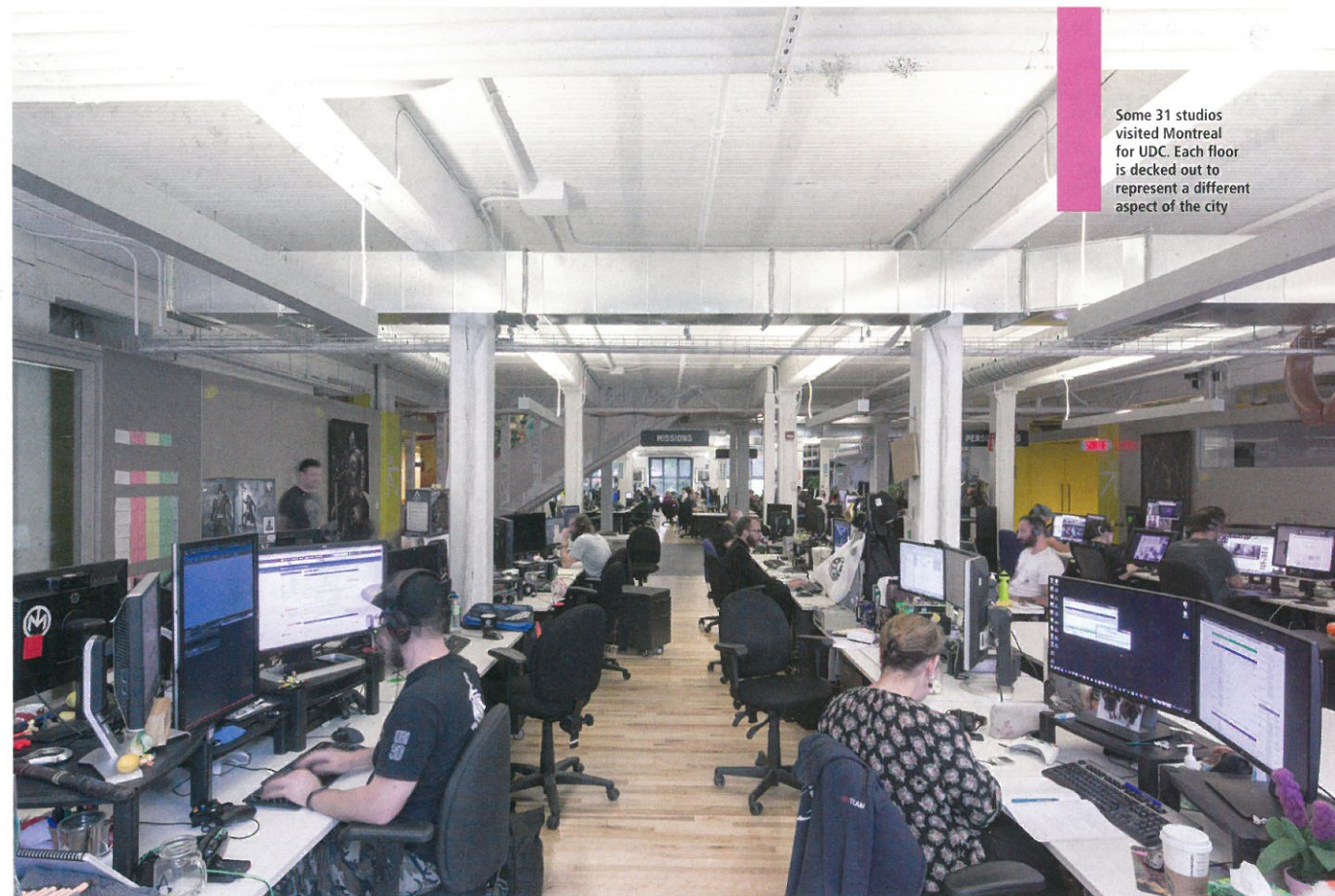
It can also apply reinforced learning techniques to determine the most likely cause of the issue, and offer a fix. While it’s not perfect just yet – the success rate is about 60 per cent – the more bug signatures Commit Assistant learns, the more accurate it will become. It’ll never force changes, however: for coders, it’s what spell checker is to writers. “It remains your decision,” Jacquier says. “It can accelerate some parts of your job, like reviewing, and directly focus on the things that might need your attention. It leaves you more time to write on different topics that you really care about.”

The idea is not simply to replace gamedevs with algorithms, but to free up their time – around 20 per cent of it, Jacquier estimates – for less tedious parts of the job. “Different production teams will decide what to do with this extra time,” Jacquier says. “Do they want to add more depth to the gameplay? Do they want to add extra features? I don’t know. They will have to answer this question.”

There’s a recurring theme to most UDC talks: devs extol the virtues of automated processes in helping prevent burnout. The robots, Ubisoft says, aren’t out to destroy us and take our jobs: in an age where teams are under more pressure than ever to keep creating new content for their games, responsible corporate applications of AI could be a humanitarian solution. “We’re trying to empower developers to spend less time on the boring parts of the job, and let them decide what has real added value.

“I think they are going to surprise us. We want them to surprise us. Everything that we’re doing in terms of AI as tools to facilitate work is really made to provide our creators with more time to surprise us, instead of having to work on repetitive tasks.” If all goes to plan, we expect to see far fewer towers from Ubisoft in the future. ■

Some 31 studios visited Montreal for UDC. Each floor is decked out to represent a different aspect of the city



Developer talks demonstrated the company-wide applications of other teams’ breakthroughs. Self-driving AI in *Watch Dogs 2* that can learn to adapt to different road and weather conditions, for instance, could be used in other racing series such as *The Crew* – and even in *Assassin’s Creed* for self-steering horses