



Microsoft Academic Case Study The University of Bradford



MAKING KNOWLEDGE WORK

Overview

Country: United Kingdom

Industry: Higher Education

Institution Profile

The university was founded in 1832, with the formation of its Mechanics Institute. It received its Royal Charter in 1966. Today, it teaches more than 6,000 full-time undergraduates and 800 full-time postgraduates.

Situation/Academic objectives

In 2003, the university was invited to a meeting with the Academia team with the Microsoft® Developer and Platform Evangelism (DPE) Group to discuss ways in which the two organisations could work together.

A true partnership

The DPE team introduced the University to a product called Terrarium built by developers using the Microsoft .NET Framework. Equipped with the knowledge of what Terrarium could do, Bradford realised that it could be modified to meet its specific Artificial Intelligence needs.

Benefits

- Helping Students to Help Themselves
- Students Take Responsibility for own education destiny
- Preparing Students for the Real world
- A foundation for other institutions

The University of Bradford Creates Intelligent Industry Links to Push the Boundaries of Students' Abilities Using AI and Gaming

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Professor Peter Cowling, MOSAIC Research Group, Department of Computing

Bradford, one of the 10 largest cities in Britain, is a friendly and thriving modern city. It is home to the University of Bradford, making it an ideal place to both study and live. Today, it teaches more than 6,000 full-time undergraduates and 800 full-time postgraduates. Like most universities today, Bradford places a strong emphasis on incorporating information and communication technology (ICT) into the teaching and learning process to empower both students and teachers to realise their full potential. In 2003, the university was invited to a meeting with the Academia team with the Microsoft® Developer and Platform Evangelism (DPE) Group. The intent was to share ideas and experience and think of ways that the two could help each other.



Microsoft®

“I was keen to promote the teaching of AI within our degree course as a whole. So, back in 2002, I decided the best way to do that would be to create an optional, final-year module that looked specifically at AI in games. I love AI, and I love gaming, so it seemed an ideal combination.”

Professor Peter Cowling, MOSAIC Research Group, Department of Computing, University of Bradford

Situation/Academic Objectives

The university's mix of vocational, technical, innovative, and practically-oriented courses contributes to its excellent record in producing employable graduates and applied research. Its mission is to make knowledge work and everything it does is underpinned by the objective of: 'Confronting Inequality: Celebrating Diversity.' In line with this vision, it works to fulfill three core aims:

- The delivery of a flexible framework of vocationally-relevant courses to growing numbers of students of all ages and backgrounds.
- The production of international-quality research, which contributes to wealth creation, social cohesion, and quality of life.
- The creation of a wealthy local economy and opportunity in the region by developing technology and offering it commercially, and by delivering consultancy, research, and training services, which support and enhance economic activity.

Like most universities today, Bradford places a strong emphasis on incorporating information and communication technology (ICT) into the teaching and learning process to empower both students and teachers to realise their full potential. It also has a highly-respected computing department, which offers many dedicated technology-orientated courses.

The department's Modelling Optimisation Scheduling And Intelligent Control (MOSAIC) research group (<http://mosaic.ac>) is committed to the investigation and development of new modelling, optimisation, and decision-support technologies. It aims to use these to bridge the gap between the theory and practice of optimisation. A key research focus is the area of artificial intelligence (AI) and its application in creating

interesting and challenging artificial game opponents. AI is created when human intelligence is simulated by machines, in particular computer systems. There are a number of processes under the AI umbrella. These include the acquisition of intelligence to comply with rules or to use information for particular purposes.

Professor Peter Cowling, MOSAIC Research Group, Department of Computing, University of Bradford, says: "I was keen to promote the teaching of AI within our degree course as a whole. So, back in 2002, I decided the best way to do that would be to create an optional, final-year module that looked specifically at AI in games. I love AI, and I love gaming, so it seemed an ideal combination.

"I came up with a few ideas that involved students competing with each other to aid motivation. I thought it would be an ideal way to stimulate learning and get them to work on more complex tasks and areas than they would normally be capable of."

A True Partnership

The MOSAIC group is always looking to partner with other organisations to work on projects of mutual benefit. It actively seeks out industrial, commercial, governmental, and academic collaborators for a range of projects in scheduling, optimisation, and artificial intelligence. These range from small consultancy projects to large, government-funded collaborations.

In 2003, the university was invited to a meeting with the Academia team with the Microsoft® Developer and Platform Evangelism (DPE) Group. The intent was to share ideas and experience and think of ways that the two could help each other. Cowling brought with him his ideas regarding how to embed AI and games into the computing curriculum.

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Cowling says: “Microsoft recognised that it could play an active and valuable role in supporting what we were trying to achieve. We both benefited from the exchange of ideas and shared experiences.”

The DPE team introduced Cowling to a product called Terrarium, a very sophisticated piece of software which implements an artificial life environment. It was built by Microsoft developers using the Microsoft .NET Framework, which allows developers to build the next generation of Windows-based applications quickly and easily, thanks to libraries of reusable code.

<http://www.windowsforms.net/Terrarium/WatlsTerrarium>

Terrarium is a game for software developers' that provides a great introduction to software development using the .NET Framework. Developers can create herbivores, carnivores, or plants and then introduce them into a peer-to-peer, networked ecosystem for a survival-of-the-fittest type competition. It's a great medium for software testing and showcases some key features of the .NET Framework, such as Windows Forms integration with DirectX® for generating powerful user interfaces (UI); XML Web services, and support for peer-to-peer networking.

Equipped with the knowledge of what Terrarium could do, Bradford realised that it could be modified to meet its specific AI needs.

The university engaged with Bradford-based Microsoft Gold Certified Partner, Black Marble, to work on software development. Microsoft agreed to sponsor the project through the provision of products such as development system Microsoft Visual Studio® .NET, training resources and materials, and additional funding to support the module. But like any true partnership,

Microsoft vowed to remain hands off in terms of dictating course content so that the university department could maintain complete control over educational direction.

Cowling says: “Black Marble has a great deal of expertise with the client/server development, while our experience and expertise lies in AI, so, coupled with Microsoft, it was the ideal partner to work with. By modifying Terrarium rather than writing something from scratch, we were able to move the project along much more quickly. If we hadn't used Terrarium, we would have had to reduce the level of complexity reached and spent more time—and money—on the basic development, which wouldn't have been the most efficient usage of human or financial resources.”

Robert Hogg, Managing Director, Black Marble, says: “Most of our employees are former Bradford graduates. That means we are uniquely positioned to understand what the university is trying to achieve and what student life there is really like. I think that knowledge certainly helped us to achieve the university's objectives.”

The university and Black Marble worked very closely during the project. The bulk of software development was carried out off site, but Black Marble kept Bradford informed throughout the development cycle, including updating it on any technical challenges.

Development started in December 2003, which imposed a very tight timeframe as the 12-week module commenced in late January 2004. So, initially much development work was conducted in parallel with teaching. The first stage of development was the development of a client and server for a board game called Virus, where students had to design and implement an AI player to choose the best move in any given position using tactical and strategic ideas. During the

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teaching of Virus, the Terrarium client and server were developed.

In order to achieve the course’s objectives, Cowling was introduced to new technology territory in the form of Visual Studio .NET and programming language Microsoft C#®. The solid partner support provided ensured an easy transition from old to new. “I had never used Visual Studio .NET before. I’d used Visual Studio 6 with Visual C++ on a number of projects and was familiar with the way it worked. But .NET was new completely to me,” says Cowling.

He adds: “It was a question of taking a punt on C#—I literally had just two weeks to get to grips with it! I found it much easier to learn because it’s easier to plug into than C++ and much easier to manage the roles of all the components such as external files and functions. It is now my language of choice for future development. Once you’ve mastered a ‘base’ language it’s not as hard to pick up subsequent development languages, such as C# quite quickly. Plus Microsoft and Black Marble were on hand to answer any queries I had along the way.”

The Result

There are three core components to the system: a client, a server—which allows students’ AI to compete—and then the AI itself. Assessment was weighted 30/70 for practical and written design work as well as the delivery of a source code printout. Students had to write two pieces of software and learn a new language, C# and Visual Studio .NET.

The first piece of coursework centred on a Virus game, which is based on an 8x8 board similar to those used in chess and draughts. It’s a two-player game (one player is black, the other white), and each player has to take turns to grow a “virus” of their own colour in competition with another virus player. More

than 600,000 games of Virus were played during a four-week period. Black Marble also produced a Pocket PC version of the Virus game so that students could play using handheld devices.

The second software assignment focused on the newly-modified Terrarium—Terrarium Academic. It was used in a survival of the fittest scenario for bugs. Students’ bugs had to find a successful path through a variety of obstacles, while seeking out goals and each other. This taught students multi-level planning, rule-based and state-based system ideas. Results were recorded using a Microsoft SQL Server™ database, part of Microsoft Windows Server System™ integrated server software.

Early on in the project, the way the server worked was configured. The department wanted to encourage students to submit lots of AI coursework and, in order to do that, it needed to be able to give feedback speedily. Initially, the server would generate feedback 24 hours after submission, but this was modified so that a student AI player picks up games immediately upon submission.

The Benefits

Helping Students to Help Themselves

Cowling was surprised at how receptive his students were to the idea of learning a completely new technology. Many students decided to study the AI for Games module because they like playing games and were keen to create AI using the same techniques as used by many of their console favourites.

Cowling says: “During one of the first lectures, one particular student was quite vocal about how he thought we should be using Java. The response from the rest of the lecture hall was quite astounding and it became clear that everyone else had faith in

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University of Bradford - Student feedback

the technology we had chosen and were looking forward to using it.”

As students were excited about the subject matter, and the way of teaching, they were more receptive to moving away from theory and on to the practical application. As a result, Cowling was able to teach much more than would normally be possible in a 12-week course. Prompt feedback meant that students were aware of their progress instantly so that they could get on and continue learning.

“About four weeks into the module, Microsoft came to visit us. I decided to build a piece of AI for the Virus game there and then. That piece of AI became the benchmark that students tried to beat. It started two-thirds of the way up the league table but then as competition and submissions hotted up, it finished at the bottom. It really encouraged students to do better,” says Cowling.

Students Take Responsibility for Own Education Destiny

Now that the first instance of the module has finished, one of the students has stayed on and is doing more AI work. At present, he is working on Terrarium to look at how it could be more usable and student friendly.

Cowling says: “It’s great to see students taking greater responsibility for their own learning and that of others. This particular student is becoming more of an expert than I am in some ways! And I receive e-mails from other students pointing me to AI Web sites and competitions, so the enthusiasm hasn’t died.”

Some students enjoyed the module so much that they created an ‘add on’ community where they could recreate functions that weren’t present in the parts of code made available to them. Feedback and the high-quality of coursework are demonstrative that

the module is an overwhelming success. Recently, a student started using the Virus client in his PhD research.

Student comments included: “I would like to state how much I have enjoyed this [Terrarium] coursework. Developing bugs has been fun and informative. This level of involvement in a piece of coursework is rare for me, and I have never enjoyed work as much as this before.”

“The development of an AI client can be very frustrating at times. However, it has also been one of the most rewarding pieces of work I have done,” commented another student.

Preparing Students for the Real World

The University of Bradford has been able to teach advanced AI and programming ideas to students, some of whom previously lacked confidence in their abilities in both of these areas prior to the course.

Students were challenged to try something different, which will ultimately benefit them. Many were initially daunted by the prospect of learning something new, but they soon realised the value it could bring them both now and in the future. For the Virus game, students wrote a class MyPlayer to complete their board evaluation function. This was inherited from the VirusPlayer class. Students were able to absorb all of the basic debugging features of Visual Studio .NET through a few hours’ of training with Professor Cowling and Black Marble.

“As a medium for teaching advanced computing ideas, I think games are unsurpassed. The motivation students have for playing and competing in games means that they’re superb for teaching purposes,” says Cowling.

“We have certainly achieved what we set out to do and more. Our objective was to raise student awareness of AI techniques and teach them about C# and .NET. The fact that we encountered a few problems along the way increased students’ willingness to learn. We’re teaching students how to use a range of technologies so that they can then choose which one to use when they enter the workplace. It’s all about freedom of choice and opening up new opportunities rather than dictating to them.”

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The university has a strong reputation for producing highly-employable graduates. In 2003, 95 per cent of graduates were in employment or full-time training within six months of graduating. It was rated seventh out of 99 universities in the country and top university in Yorkshire for graduate employment, according to The Times Good University Guide latest league tables. The knowledge gained during the module will help maintain this leadership. Above all, it will put students in a strong position when they enter the world of work, as they have now broadened their skills base.

Cowling adds: “The sorts of things we see on Star Trek and films like I Robot are fast becoming achievable. And we need people who understand AI at a very deep level to take advantage of the opportunities and benefits it can bring. We need to start training the software engineers who are going to create very useable computer systems as they simply won’t happen by accident.

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Building a Foundation That Other Institutions Can Build On

It is becoming increasingly obvious that interest in computing and related courses is declining. Across the board, student intake is down some 30 per cent year on year. That leaves universities in a predicament and they must remain highly competitive to ensure their continued success. Bradford faces the

same challenges and strives to ensure that it can offer compelling, stimulating, and relevant computing courses for students, as well as a professional and happy working environment for teachers.

The University of Bradford, Black Marble, and Microsoft hope that games will be used as a medium for teaching AI and software engineering more widely. To help ensure this happens, they plan to make available, free of charge, the clients and servers for the Virus game and Terrarium to other universities and teaching institutions.

The module’s success has also generated a great deal of interest from other universities, such as Hull, who are currently using the Virus software in their AI teaching.

Cowling says: “The interest from other institutions is important for us. Also, the fact that people can learn more in AI as a result of what we’ve done. The university, Black Marble, and Microsoft should be very happy with what we have achieved in AI for Games. I believe the two pieces of software we have developed have the potential for much wider use, and I look forward to having the opportunity to discuss this further with others.”

The university also plans to use .NET with mobile applications and will use the Virus and Terrarium courseworks as examples of best practice to help move the project forward.

Why Black Marble?

Black Marble is an established Microsoft Gold Partner who specialise in bespoke software development for the Microsoft Platform. With a wide range of expertise and development skills, Black Marble are able to produce solutions as diverse as quoting systems for large international insurance underwriters, interactive GPS solutions for Microsoft mobile platforms, and 3D real-time modelling. Black

For More Information

For more information on the services and resources available to students, faculty members and system administrators in computer science, engineering and information systems departments in UK academic institutions please visit: www.microsoft.com/uk/academia

For more information about Black Marble products and services, call +44 (0)845 644 7656 or visit the Web site at: www.blackmarble.co.uk

For more information about University of Bradford products and services, call +44 (0) 1274 232323 or visit the Web site at: www.bradford.ac.uk

Marble is proud to have had a long relationship, in research, development and teaching, with Bradford University

Why Microsoft?

Bradford is part of the Microsoft Academic Alliance (MSDNAA), so has a history of using Microsoft technology within the institution to support teaching. However, traditionally, most students chose to develop using Java rather than Microsoft languages or technologies. Bradford was going against the norm by working with Microsoft technologies for this module. This decision has proved to be a good one, and students now have more software development skills in multiple languages.

Cowling says: "Microsoft is often criticised for having too much of a business focus when engaging with academia. But I think it's working really hard to transform the relationship it has with institutions. The Academia DPE team is a great champion of that. Microsoft is a committed and caring partner, and seeks to build long-term relationships with institutions like ours.

"And realistically, for what we're trying to achieve, it's foolish to try and make too much of a distinction between academia and business. That's because 95 per cent of what we do is to support U.K. Plc.

The other five per cent focuses on doing things with a 20 year outlook for U.K. Plc. So I'd be extremely uncomfortable about producing graduates with little awareness about Visual Studio .NET and C# and their roles in the corporate world. This relationship has been so successful that we certainly plan to work with Microsoft and Black Marble again on follow on projects."

Software and Services

■ Products

- Microsoft Visual C# .NET
- Microsoft Visual Studio .NET 2003

■ Technologies

- Microsoft .NET Framework