A Message from Professor Cormac Sreenan, Head of Department

Welcome to our latest newsletter for Computer Science at UCC, in which we focus on our relationship with industry.

We pride ourselves on our exceptionally close engagement with industry, across a wide range of sectors. Our interactions take many forms, including work placements, student projects, and technical briefings, but increasingly we also collaborate with companies on advanced research projects. So, we start this newsletter by highlighting a few recent research collaborations with industry.

The Department has the unique privilege of playing a leading role in three major SFI-funded Research Centers, each of which is happy to welcome new industry partners. CONNECT conducts research on future networks and communications, Insight is focused on data analytics research, and Lero is a software research centre.

The Department also has a vibrant role to play in growing the economy. Throughout the year we regularly meet with visiting companies hosted by the IDA, who wish to learn about our degree programmes, graduates and research strengths. Of course it is most rewarding if subsequently a company does come to Ireland. A recent example, in October the US company Cylance announced 150 jobs for Cork at the formal event with Minister Mitchell-O’Connor. The company stated that proximity to UCC was a very important factor in their decision.

Also in this edition we share with you the many and varied achievements of our students and staff, of whom we are very proud. Enjoy!

Computer Science Research Strategy, Professor Ken Brown, Chair of the Research Committee

Digital technologies and ICT are having an ever-growing impact on industry, the economy and society. Innovations and opportunities are becoming more visible, in areas like autonomous vehicles, drones, big data analytics, personalised medicine, the Internet of Things, and 5G communication networks. These opportunities also bring threats, to our individual privacy, to the security of our national infrastructure, and to our personal safety, and raise fundamental issues in the ethics of data analytics and the behaviour of autonomous systems. An active national and international research base is vital, to produce new innovative solutions, to support industry based in Ireland, to develop new technology for the benefit of society, and to explore the consequences of these new technologies.

The Department of Computer Science in UCC is fully focused on these challenges, and is playing a leading role in national and international programmes.

Our research is focused on two main areas: (i) artificial intelligence, analytics and human computer interaction, and (ii) communication networks and cloud technologies, and both groupings have active programmes applying our research in the areas of health and well-being, innovative enterprises, and environmental sustainability.

The recent UCC research quality review, conducted by panels of international and independent subject experts, assessed our research groups in both areas as being ‘outstanding’, with the highest possible rating for the levels of funding obtained from open competition, and noted our impressive outreach activities and industrial engagement.

A flavour of some of this research and activity is given in the articles which follow.
A €1.5m investment in Insight UCC by United Technologies will advance research in smart service delivery and supply chain management in Cork.

Connecticut-based United Technologies Research Center (UTRC) recently announced an investment of €500,000 in cash and €1M in in-kind contribution in the Insight Centre for Data Analytics at University College Cork (UCC) within the Department of Computer Science.

The research conducted at the Insight Centre as a result of this investment will focus on four key areas: artificial intelligence, data analytics and machine learning, human machine interaction, and optimisation in collaboration with United Technologies Research Center staff.

UTRC is the research organisation and innovation engine of United Technologies Corporation (UTC), which provides high technology systems and services to the building and aerospace industries and employs approximately 200,000 worldwide.

Having worked with researchers in Cork since 2010, UTRC’s latest investment represents the company's largest in Ireland and the most valuable targeted project in Science Foundation Ireland’s (SFI) research centres programme to date.

UTRC’s €500k cash commitment will be matched by the Irish government through the SFI research centre’s programme.

The Insight Centre for Data Analytics is the largest of 12 SFI research centres, and comprises 400 scientists working across a range of data fields.

Insight director and UCC computer science Professor Barry O’Sullivan said, “Smart Enterprise is an area of strategic importance for the Insight Centre.

With the investment that UTRC has announced today, researchers in Cork will be able to build on a decade of world-class artificial intelligence research. Our work here in Insight will play a key role in the delivery of smart services and supply chain management across a number of sectors.”
Industry and Academia come together to solve video streaming problems

A team of SFI-funded researchers in the department’s Mobile & Internet Systems Lab (MISL) led by Professor Cormac Sreenan are improving the delivery of stored and live video over wireless networks. US-based AT&T Labs Research and Dell EMC, with a base in Cork, are the two industry partners in the iVID project, and work closely with the UCC team on this challenging and timely issue. A key element of the UCC research is to exploit the emerging capabilities of software defined networks to improve the way in which networks control the flow of video through routers and base stations, both cellular and WiFi-based. Software-defined networks are a focus of considerable attention throughout the internet and telecoms sectors, promising to reduce the cost of network deployment and enable a leap in network management flexibility and capabilities.

Thus far, the iVID researchers have developed a novel experimental software platform and key inventions that have been shown to reduce the amount of video stalling relative to the state of the art. The problem of video stalling is caused when multiple video flows compete with each other for the network capacity, and is rated by users as the most annoying issue when watching video over wireless networks. Speaking of the industry engagement Professor Sreenan said that having direct access to AT&T and Dell EMC allows UCC to “gain an industry perspective into practical problems and constraints, thus also improving the likelihood that our inventions will have real impact.” Aside from research, several research staff members from AT&T visited UCC earlier this year and delivered a 2-day course entitled “Towards NFV-Based Mobile Video Delivery”, in which 30 people participated, drawn from a range of companies and other Irish 3rd-level institutions. The University of California Riverside is also a key partner in iVID, bringing important experience in the design and evaluation of network protocols. UCC’s MISL is a leading member of the national CONNECT research centre for future networks and communications, through which it partners with companies on projects ranging from dense WiFi deployments to the Internet of Things and sensor/actuator networks.

iVID project team: Professor Cormac Sreenan, Dr Ahmed Zahran, Dr Jason Quinlan, Mr. Ahmed Khalid, Mr. Darijo Raca, Mr. Aleksandr Reviakin.

For further information please contact: Professor Cormac Sreenan, cjs@cs.ucc.ie

The iVID project architecture, showing content distribution and video servers, enabling high-quality video delivery over the SDN-controlled network.
Increasing wait times for appointments at out-patient clinics affect patient safety and quality of life, and have become a topic of national interest.

- The needs of urgent and more routine patients need to be considered at the same time to find the right balance of allocating resources.
- Capacity in a particular speciality may vary from hospital to hospital within a region. Balancing resources and/or reassigning patients can improve overall service levels.
- Hospitals need tools to understand changing demand and where to invest in improvements.

Insight developed a tool to analyse the current state of the waiting lists, predict future demand and capacity, and optimise the reservation strategy used in daily operation:

- A simulator understands the impact of cancellations and patients not attending their appointment and finds the best use of capacity in multiple clinics and locations.
- The system can also be used as a “What-if” analysis tool to understand potential changes in demand and supply.
- The tool provides results to different stakeholders in the form of customized dashboards.

The key outputs of this research include:

- Optimise the resource allocation across clinics and locations to reduce wait times and achieve more equitable access to out-patient services.
- Quantitative analysis of the impact of potential service changes.
The solution includes the development of a Health Sector Simulator to optimise the throughput of patients in medical clinics. This involves the collection, consistency checking and analysis of data associated with hospital facilities, equipment, medical personnel and patients. The solution can be integrated into Abtran’s Technology Platform, enabling them to leverage systems already created to resolve a key challenge in the Health Sector in Ireland and beyond.

**Insight UCC project team:**
Professor Barry O’Sullivan, Dr Steve Prestwich, Dr Helmut Simonis, Mr Adrian O’Leary, Mr Mike O’Keeffe, Dr Carlo Manna, Dr Chrys Ngwa

For further information contact: Dr Chrys Ngwa, External Relations Manager, chrys.ngwa@insight-centre.org T: +353 (0) 21 420 5957

**Abtran:**
http://www.abtran.com

With our knowledge of the working environment and practices on the ground together with Insight’s expertise in Data Analytics, we were able to develop a solution to recommend alternatives to alleviate the wait list problem in the HSE and to optimise existing clinic capacity”

Martin Leahy, CTO Abtran
On April 16th of this year, I moved to Boston for the summer. I was both excited and terrified to leave Ireland for 21 weeks, but the trip was one to remember.

Working at MIT was, at the same time, thrilling and exhausting. I worked in the “Network Coding and Reliable Communications Group” in the “Research Laboratory of Electronics”, implementing an atomic algorithm for large-scale distributed systems. Research requires a lot of self-drive.

Not only did I have to teach myself different programming languages, such as Golang and C++, but there was a certain level of maths involved, way past the level I had achieved to date. The difficulty of the work was softened somewhat by the atmosphere on campus.

MIT students have certainly mastered the “work hard, play hard” way of life. Their ‘hacks’ are famous across Boston, some of which included somehow putting a police car on the dome (Dunkin’ Donuts box and all) and measuring the Harvard bridge using a fraternity pledge (it’s 364.4 smoots ± 1 ear if you’re wondering).

The wide-spread campus itself allowed for much-needed walks to clear my head. During my lunch hour, I would stroll through the campus, along the “Infinite Corridor” (don’t get excited, its length is actually finite), on the green at Killian Court or sometimes to the gorgeous Baker library hidden underneath the famous dome.

Another reason why I loved my time away was Boston itself. While at first it was a whole new world, full of identical-looking streets and strange accents, by the time I left it had become a second home. I knew the neighbourhoods, each unique, from colonial Beacon Hill to prestigious Back Bay and across the Charles to hip Cambridge. No longer did I need a map, I lived for long walks through the city, trying to get lost in order to find the real Boston. The people, while completely multicultural, create a harmonious and accepting atmosphere I have yet to find in any other city. The 35 universities in Boston draw students from all across the globe, giving the city a sense of youth and learning, while also ensuring the large distribution of coffee shops to the delight of many.

I’m so thankful to the Computer Science department in UCC and RLE at MIT for allowing me this amazing opportunity. It has always been a dream of mine to experience the life of a scientist, working on the cutting edge of technology, enhancing computer systems that will make a difference in the lives of many. As I continue my project with MIT through my final year of computer science, I dream that someday I’ll be able to return to Boston and walk through MIT campus once more.

Emily Horgan, 2016 graduate presented final year project at a Thai University

Studying Computer Science has opened up many doors for me both professionally and socially - not only have I made great business connections and have a solid platform in which to seek employment, but I have also been lucky to make lifelong friends who share the same interests. One of the greatest opportunities I’ve been given throughout my time studying computer science in UCC was to fly to Bangkok, Thailand last May and present my final year project at a three day conference in KMUTT (King Mongkut’s University of Technology Thonburi).

KMUTT is a purely technical college, so engineering, architecture and computer science are the main courses studied there. Most are taught through Thai, but many are taught in English.

UCC has a connection with KMUTT, with many of their students coming to Cork to learn English each summer. Summer 2016 was our turn to visit their campus and take part in their annual senior project conference, which invited students from colleges in Singapore, India and Taiwan to name but a few to present the projects they developed during their undergraduate studies.

UCC sent three representatives – an Engineer and two Computer Scientists, myself included. The long travel (16 hours, including stop overs) was well worth the warm welcome we received from the students there. They could not have been more accommodating, welcoming or interesting. The first evening of the conference was spent giving cultural performances and backgrounds to each college. The idea of studying in UCC went down really well with all of the students, as did the beautiful scenery and landscape that Cork had to offer. We also managed to teach the conference attendees a bit about Irish Dancing which they all really enjoyed. Apparently, Micheal Flatley is a hero in Taiwan.
The second day was the main day of the conference where each student presented their projects. What I found the most interesting throughout the day was the diversity of the projects displayed. While the majority of the students attending had backgrounds in Engineering, our projects really held their own. Topics ranged from my own project, which focused on the importance of User Experience and User Interface design for mobile and wearable applications, all the way to self-driving cars, 3D printing of medical devices and braille clocks. The mix of different branches of engineering (civil, electrical, chemical) and UCC’s computer scientists made it an extremely interesting conference.

Aside from the projects, the students of KMUTT brought us to many of the main attractions throughout Bangkok and in general, treated us like close friends. It was mutually beneficial, as the students were interested in bettering their English, while we were interested in soaking up as much culture as possible.

Because we had managed to get to the other side of the world, I continued my travels around South East Asia for a further three weeks after the conference – the first two weeks accompanied by one of the other UCC students who attended the conference, and an extra week on my own. I can honestly say that I would not have even considered visiting Thailand this summer without the support of UCC. Not only was I rewarded with a whole new cultural experience, but it meant that the hard work I had put into my final year project all year was validated and appreciated by an audience which I never thought would see it. I made connections with students and professionals from all over the world who appreciated my work.

This opportunity would not have arose if it were not for the support of my lecturers, the staff in the computer science department and of course, the college itself. For me, I could not think of a better way to finish.

Unbeknownst to most people, there are computer programs silently working in the background to optimise and improve the world around us. These computer programs are called solvers and work on solving a variety of different problems. Solvers are used to schedule buses, trains and planes; design processors in phones, and computers; schedule machines and workers in factories and find the fastest routes by deliveries. Society relies heavily on these complex programs and yet most people aren’t even aware they exist.

A solver’s setting controls everything from the strategy used to solve the problem to the number of attempts made before trying a different approach. Collectively, a bunch of settings are known as a parameterisation or configuration. Due to the large number of settings in a configuration we face a problem known as a combinatorial explosion where the amount of options grows extremely rapidly.

Solvers can sometimes run for days or even weeks, but by finding the correct combination of settings solving time can be reduced to minutes or seconds.

My research focuses on finding good parameterisations for these programs while they are solving a stream of problem instances. In order to tackle this difficult problem I use four R’s: Race, Rank, Remove, and Replenish. Racing involves making multiple copies of the same solver program with different parameterisations. These are then raced against each other in parallel on different cores of a computer.

The first finished is deemed the winner while the others are stopped running.

Ranking is done using a ranking system called TrueSkill, which was originally developed by Microsoft to provide balanced matches in games like Halo. TrueSkill provides a score to each setting using Bayesian inference, a way of updating beliefs based on the observations made. TrueSkill is able to gauge the relative skill of different settings quickly. This allows us to use only the settings that perform best going forward, thus guaranteeing a certain level of performance for the solvers. TrueSkill also provides a confidence score, which allows us to safely remove parameterisations that are underperforming.

A removed parameterisation is replaced in one of two ways. The first mutation takes a highly ranked configuration and randomly changes some of its settings in order to create a new configuration. The second option for creating new parameterisations is called crossover. With crossover, two parameterisations are selected from those currently in use. Half of the settings are then taken from the first parameterisation and half taken from the second to produce a new parameterisation that hopefully takes the best from both.

Real world tests on combinatorial auctions show that these techniques can speed up solvers a lot. A combinatorial auction is a type of auction where people bid on packages of multiple items and the auctioneer must find the set of non-overlapping bids to maximise profits. The solver took more than four days using the default settings to solve 2000 of these problems. Using our system to find good settings the solver took just one day, six hours, that’s a 70% reduction in solving time!

This is a general system that can be applied to solvers solving any of the everyday problems around us so research in UCC could be helping your Christmas package arrive more quickly!

Solving problem of computer programs that are too slow, Tadgh Fitzgerald, PhD student, Insight@UCC

Tagdh Fitzgerald, PhD Student, Insight, Department of Computer Science, UCC
Developments in Music Technology have seen major changes in the manner in which artists, performers, and creatives interact with digital technology; this is arguably due to the increasing variety of digital technologies that are readily available today. Digital Musical Instruments (DMIs) present musicians with performance challenges that are unique to computer music. One of the most significant deviations from conventional acoustic musical instruments is the level of physical feedback conveyed by the instrument back to the user. Currently, new interfaces for musical expression are not designed to be as physically communicative as acoustic instruments. DMIs are often void of physical feedback and therefore lack the ability to impart important performance information to the user. Moreover, there is currently no standardised way to measure the effects of this deficit. In a design context, best practice would expect that there should be a set of methods to effectively, repeatedly, and quantifiably evaluate the various elements of functionality, usability, and user experience involved in a DMI interaction. Earlier applications of haptics have tried to address device performance issues associated with the lack of feedback in digital device designs and it is argued that the level of haptic feedback presented to a user can significantly affect the user's overall emotive feeling towards a musical device. In my research I explored a number of techniques in which physicality could be reintroduced to digital interactions with musical devices. I conducted psychophysiological studies that measured the effects of vibration, designed an evaluation framework that could be applied to musical instruments, and presented functional and longitudinal studies that applied the framework in the evaluation of haptics applied in computer music.

In June 2016, the Department of Computer Science launched the first PhD poster day. On the day, each PhD student presented a poster highlighting their work. Chair of the graduate studies committee, Dr Ian Pitt, congratulated the students on their excellent progress and wished them continued success. It is hoped to open the poster day up to a wider audience in the coming years. The posters are available to view at http://www.ucc.ie/en/compsci/posters/.

Student scholarships
In 2016, the following students received the College of SEFS International George Boole Scholarships.
• BSc Computer Science - Karan Samani
• MSc Data Science & Analytics - Xinqi Li
• MSc Data Science & Analytics - Mohammad Azam Shah
• MSc Data Science & Analytics - Bhat Vikram
• MSc Computing Science - Shin Nay Lin

Thai Alumni Scholarship
• MSc Data Science & Analytics - Benjarat Tanthanasirikul

Government of Ireland Scholarship – UCC Scholarship
• MSc Data Science & Analytics - Octavio Vázquez Mendoza

L to R: Karan Samani, Mohammad Shah, Bhat Vikram, Professor Cormac Sreenan, Shin Lin, Octavio Vázquez Mendoza

(L to R) Professor Eduardo Miranda, Gareth Young, Dr Ian Pitt
On Wednesday 26th October, DELL EMC launched an exciting new mentoring program for 2nd and 3rd year female Computer Science students at their Cork offices in City Gate, Mahon.

This innovative mentoring program connects female students within STEM disciplines to female mentors at DELL EMC in Cork. The event was attended by 20 students and 20 experienced industry mentors with a panel of speakers such as, Gillian Bergin (Operations Director, Dell EMC), Jacquie Casey (STEM Aspire Founder), Siobhan McFadden (IT program manager) and UCC student computer science ambassador Louise Fox.

“The overall aim of the program is to encourage and empower female students to graduate and join the growing number of women pursuing exciting careers in science and technology” said Gillian Bergin who also sits as Director of the Board, IT@ Cork European Tech Cluster.

The genesis of the program was a discussion last year between Jacquie Casey from Dell EMC and UCC student Louise Fox at a networking event where concern was shared regarding the rate of females dropping out of Computer Science within 3rd level colleges. This sparked the idea of providing access to real life mentors and role models within DELL EMC to these students. The STEM Aspire program was launched in January 2016, with events consisting of speed mentoring, a book club, site tours and inspirational talks from female leaders in STEM.

At the launch, Professor Cormac Sreenan, Head of the UCC Department of Computer Science, said that “The positive role of mentoring for students is widely accepted and here in UCC we are delighted with the new Dell EMC mentoring initiative for our female undergraduates. This builds on our close and well established partnership with the company.”

“In the words of Marian Wright Edelman - You cannot be what you cannot see” said Jacquie “It’s important for these students to be able to visualise their career possibilities and to be inspired by females who have blazed this trail before them. As a diverse company, we at Dell EMC are able to provide these students with realistic role models at every level- we have female Software Engineers, Developers , Testers, Tech Support, IT Program Managers and Directors and Board Level VPs – all delighted with the opportunity to share their experience and offer advice and encouragement.”

Gillian Bergin also addressed the group sharing her tips on what she calls “Nat-Working” or “natural networking”. She urged the students and mentors to use every networking opportunity to promote the female STEM story in a positive light adding “that careers in tech are creative, exciting and rewarding and it’s up to all of us to share that message and support each other in our career journeys.

Having female mentors is proven to enhance women’s motivation and aspirations. Women who don’t know other women in STEM are likely to feel more isolated, which can undermine confidence.

We want to address this issue by providing access to an empowering mentoring program”

Final year UCC computer science student and STEM Aspire student ambassador, Louise Fox also shared her experience of the STEM Aspire program. “I would highly recommend this program to any student looking to gain an insight into working life; it is a great opportunity to develop professional relationships with industry experts. It has opened my eyes to the myriad of exciting careers I can pursue with a STEM qualification and the right mentoring support. The potential that stems from this program is invaluable.”

The Mentoring program will also be offered to 1st year students in 2017. For further details please contact Jacquie Casey at jacquie.casey@dell.com

Students and mentors working together at the DELL EMC “STEM ASPIRE” Mentoring Program

Computer Science students attending the DELL EMC “STEM ASPIRE” Mentoring Program
Professor Michel Schellekens was selected by UCC to be honoured with the 2016 Impact Award in recognition of the significant contribution he made during the UCC Year of George Boole 2015 for proposing and leading the “In Conversations on George Boole” project.

"Through his dedication and commitment to this project, he has ensured that the importance of Boolean logic which underpins the significant contribution of George Boole has been highlighted and captured for generations to come.

He displayed remarkable creativity and innovation in the development and delivery of the “In Conversations on George Boole’ project together with his significant engagement with national and international collaborators and stakeholders.”

The "Conversations on George Boole” project, comprised interviewing sixteen of the world’s experts on Boole related areas. It was realized through a considerable effort of UCC staff; full implementation, including archiving and storing, will last two years from start to finish.

The interviews, carried out by Professor Schellekens, were filmed on location by Stephen Bean at UC Berkeley, the Fields Institute, MIT, Stanford University and NASA’s Kennedy Space Centre can be found at http://georgeboole.com/conversations/. The Boole Legacy Interviews reflects the tremendous international respect for George Boole and Claude Shannon, whose work builds on Boole’s by modelling switching circuits based on Boolean algebra. The interviews and accompanying excerpts are currently archived at our Boole library.

The sixteen interviewees brought the figure of George Boole to life with their combined enthusiasm and deep insight in his life and work. They shared comments on important yet relatively unknown inventions by Boole, information on his stunningly beautiful mathematical techniques, interesting aspects of Boole’s history as well as the surprising impact of his work on other areas, the hardware industry and IT in general. Interviewees also addressed the controversies on the quality of Boole’s work—a passionate story that only has been fully resolved in the past few decades in Boole’s favor. They also advocated that Boolean logic/circuits, a concept as fundamental as numbers, should be included in the secondary and even primary education curriculum.

Barry O’Sullivan, Professor of Computer Science at UCC, receives top SFI award and elected as Deputy President of EurAI in 2016

Barry O’Sullivan, Professor of Computer Science and Director of Insight at UCC has received two remarkable accolades in 2016. In November he was named SFI Researcher of the Year, recognising his significant contribution to the Irish research community in his career. He has been honoured for his “exceptional scientific and engineering research outputs” combined with his ability to communicate and, where appropriate, exploit his research. Earlier this year, he was elected as Deputy President of the European Association for Artificial Intelligence (EurAI) at its General Assembly held in The Hague.

Professor O’Sullivan, who became the first Irish member of the EurAI board after being elected in 2014, said: “It’s a huge honour to be the first Irish person to serve on the board of the European Association for Artificial Intelligence, so to be elected as its deputy president is a major thrill.”

EurAI, formerly ECCAI, was established in July 1982 as a representative body for the European artificial intelligence community. Its aim is to promote the study, research and application of Artificial Intelligence in Europe. EurAI has more than 4,500 members across more than 30 countries, making it the largest AI organisation in the world.

Professor O’Sullivan commented: “The Association needs to step up its game in terms of how it represents the artificial intelligence community in Europe. For example, we need to actively contribute to and inform the ongoing debate about the future impact of AI, the responsibilities that the technology brings with it, and the many ethical issues that it raises.

“We also need to engage very directly with European policy-makers so that the quiet position of strength that Europe has in AI is developed and exploited to the benefit of its citizens.

The project was supported and coordinated by UCC’s office of the VP for teaching and learning, Professor John O’Halloran. The legacy interviews were funded by UCC’s Boole Committee (members of which have been highly supportive throughout the project), the INSPIRE national graduate education programme coordinated by Tyndall (Aoife Deane, Jim Greer, Ruth Maguire) and a contribution from John Fitzgerald, Director of Information Services, UCC.

For example, there are huge opportunities for major corporate investment in AI-focused industrial R&D labs in Europe, which we are currently missing. EurAI has a role to play in creating an awareness of the consequences of not fully benefitting from Europe’s strength in artificial intelligence.”
Our students and staff continue to receive international recognition for their research. Best paper prizes awarded in 2016 include:


- Emer O’Connell, Mark Corrigan, Elaine O’Conner, Laura Samh, Joe Pegler and Sabin Tabirca, “The impact of NFC technology in hospital ward to reduce medical errors”, won the 2016 David Bouchier Hayes Innovations in Surgery Award, National Royal Academy of Medicine. (innovation award)


- David Tracy, C.J. Sreenan “CacheL: A cache algorithm using leases for node data in the Internet of Things” 4th International Conference on Future Internet of Things and Cloud (FiCloud) in Vienna, Austria, August 2016. (best paper)
MPT Graduation May 2016

Delegation from Beijing University of Technology (BJUT) hosted by Department of Computer Science, UCC, November 2016

Welcome gathering for international students, September 2016

Irish Collegiate Programming Competition contestants April 2016