Cathal Garvey

Information Security Enthusiast, Programming Polyglot

contact

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research

Lean Biotech R&D
Science Communication
Computational Biology
Synthetic Biology
Precision Gene Therapy

programming

Python, Lua, Coffeescript, Javascript, CSS3 & HTML5, Mozilla Rust, Haxe, Java, Cobra (CLI), Haskell, ANSI C, LaTeX

interests

Synthetic Biology, Bioinformatics, Programming, Cryptography, Data Analysis & Visualisation, Open Data, Open Science, Permaculture, Cycling, Writing, Hiking, Linux & FLOSS

Formal Education

2003–2007 **Bachelor of Science, Genetics** — NUI-Cork / University College Cork

Focus on Medical Genetics, Bioethics, Virology, Bioinformatics & Plant Science. Penultimate year project on plant immune response and soil potentiation of plant disease resistance. Final year project on murine pregnancy-specific glycoproteins & PCR recovery of same. Graduated 2H1 with consistent honours.

Professional Experience

2012–2014 **Glowbiotics Ltd** — Cork, Ireland

Founder, Chief Executive Officer

Two years in a venture-funded startup pioneering lean biotechnology and computational DNA design for synthetic biology. Wrote a number of in-house DNA software design tools, designed and used in-house hardware designs to reduce costs and accelerate research. Collated and compiled protocols and SOPs based on deep literature research that saved time and money while remaining efficient and reliable. Conceived and designed a series of ambitious DNA-based products with many novel and positive results, using own software. Key skills: Hardware, Software and Wetware design, Regulatory compliance, Administration, Synthetic Biology, Computational Biology

2014 **Open Innovation Partners Ltd** — Cork, Ireland

Contract Software Engineer

Contracted to produce a business intelligence & data-visualisation platform for co-authorship data via the NCBI EUtils API in order to perform due diligence consultations and to discover and assess potential future academic collaborators. Given a name or a MeSH heading, a connectivity graph with visual indicators of academic impact could be produced and interactively explored. Key skills; EUtils XML API, Dynamic XML to JSON conversion, SQL backend storage, Web Application development (Flask), High Performance Code, Data Processing/Visualisation (D3), UX Design

2013–2014 **Science Gallery** — Trinity College, Dublin, Ireland

Exhibit Curator

Co-curated a flagship exhibit exploring the future and cultural role of Synthetic Biology. Assisted in selecting, coaching and properly exhibiting pieces exploring democratisation of science and technology, speculative med-tech design, trans-humanism and radical or guerilla bioremediation. Provided a number of workshops and residencies on synthetic biology & genetics. Key skills: Science Communication, Technology Consultation, Co-Operative Design

2007–2010 **Cork Cancer Research Centre** — Cork, Ireland

Research Assistant

DNA design, cloning & artificial gene synthesis for gene therapy vectors. Academic review support for projects related to targeted, integrative gene therapy. Received training in mammalian cell culture, laboratory animal welfare & handling. Received, processed & stored a number of primary human tissue samples for research use. Conducted gene therapy trials on in-vitro mammalian cell cultures. Key skills: GMP & HACCP, Cell culture, Microbiology, Synthetic Biology

Memberships

2014 **Secretary** — Cork Biomakerspace

(In progress) Founding, locating and outfitting a biolab suitable for community, outreach, educational and start-up use in Cork City Centre with support from local industry, academia and state bodies. Areas of interest include synthetic biology, computational biology & bioinformatics, and medical or food technology.

2012–2014 **Leonardo** — Science Gallery "Leonardo" Group, Trinity College Dublin

Serving as member of Leonardo think-tank, providing technological consultatoin and creative input on present and future exhibits, knowledge and input to events, membership on various panels and for collaborations and future exhibit curators. Collaborations with designers, artists and technologists through the Leonardo group have been occasional and valuable professional experiences.

2009-2014 **Founder** — Nexus Cork Makerspace

Founded a successful maker/hacker-space (information technology club) which has held stable residence in a central location and which has hosted a variety of technology related events including bioinformatics workshops, 3D modelling classes with associated 3D printing, and corkdev.io programming meet-ups.

2011 **Bioethics Delegate** — DIYbio.org Bioethics Congress

Participated in creating a widely accepted, terse yet expressive code of conduct for independent researchers and amateur biotechnologists based on firm Bioethical first principles. Disseminated and advocated this code of conduct which is now widely accepted.

Software

2012 **PySplicer** Github

Wrote a cutting edge DNA design tool, PySplicer, which implements current research in codon and coding sequence optimisation, surpassing all other freely available tools. Used in-house to design fluorescent protein expression constructs successfully, with exceptional expression levels. Contributing this to the biotechnology sector has enabled me and others to design DNA at an accelerated pace, and has challenged a monopoly on up-to-date DNA design tools by existing DNA synthesis providers.

2013 **DNcode** Github

Wrote a compression function for nucleotide sequences which could rapidly & losslessly compress DNA or RNA sequences to one quarter of their original storage size, in linear time and which could easily be implemented at database level without significant performance loss. The algorithm has since been re-written in several other languages and a Mozilla Rust port is underway to provide a high-performance compiled library for databasing applications. Given the growing surfeit of sequencing data in use and in transit across academic networks today, DNcode could provide a much-needed reduction in storage and bandwidth costs.

2013 **Litmoria** Private / Proprietary

Wrote a search-engine and data-visualisation framework for academic data, graphing co-authorship connectivity, authorship volume, last-author frequency, & degree-of-separation for data from NCBI Pubmed. The engine allows arbitrary search patterns by author name or by keyword, and has been instrumental to the client in evaluating potential academic partners, as well as seeking unaffiliated yet academically well-placed partners for due-diligence prior to investment or partnerships.

2013 **deadlock** Github

Implemented the miniLock.io peer-reviewed cryptosystem in Python using PyNaCl, pyblake2 and pylibscrypt. Achieved 2,000 downloads from the PyPI repository within 48 hours of launch, currently negotiating a commercial licensing agreement with a cloud services provider in the US for trivial, secure delivery of logging data to clients. Participating in design of version 2 of the miniLock encryption scheme, with plans to generalise encryption scheme for use in email or for securing shared folder schemes such as Dropbox through public key cryptography.

2013 **tinystatus** Github

Implemented a peer-to-peer microstatus network in 30 lines of Python (and again in readable, properly formed Python) incorporating spam/flood resilience and ability to ”follow” not only users but arbitrary regular expressions. Feature set was limited by the constraint that only built-in Python modules be used, yet the system was successfully tested on a demo server for several weeks without issue.

Hardware

2009 **Dremelfuge** Github

Having a need of a centrifuge for work in my own lab, and perceiving a general need for a low-cost, high-speed microcentrifuge for medical applications in deprived areas, I designed a 3D-printable rotor for common rotary multitools which could be fabricated for approximately €1 and which could easily accomplish routine medical and laboratory centrifugation. The designs were made available generally, and have been exceptionally well received.

2011 **PID Water Bath Controller** Private Implementation

Needing a water-bath and scandalised by the prices quoted for such a simple piece of equipment, I designed a microcontroller-driven feedback system and AC power controller which could be used with domestic equipment (to wit, a kettle) to provide a water bath solution for general use. Upgrade to an edge-immersion, fan-agitated system was partially implemented but was found to be unnecessary.

2012 **OpenPyCR** Github

For reasons of cost-effectiveness and ease of customisation, I made use of an OpenPCR thermal cycler for polymerase chain reaction and other enzymatic or cell reactions requiring precise timing and temperature control. However, the software provided was poorly customisable and required software I was unwilling to install for security reasons, so I re-implemented the hardware control software from first principals, and extended it to allow a terse and human-readable specification of program flow in plain text.

2009 **MicroLathe** Thingiverse

As an experiment, designed and 3D printed parts for a rotary-tool-powered miniature wood lathe and successfully used it upon a small section of dowel. Made two revisions, with the second providing a drastic improvment in stability while reducing printed mass. This design was likely the first 3D printed lathe design, but has since been surpassed by more ”serious” designs.

Biotech

2010 **IndieBB (1)** Glowbiotics

Identifying a market need for a robust & modern-standards compliant plasmid DNA vector for *B.subtilis*, I manually designed a vector which would enable antibiotic-free selection & maintenance and which provided ”biobrick” compatible cloning sites. The selection scheme worked as intended but the plasmid vector itself proved unstable; I would later learn that the CDS optimisation systems I was using were just becoming deprecated with new research, leading to the authorship of the *PySplicer* DNA design tool, above.

2012-2013 **Fluorenzymes** Glowbiotics

Desiring to produce and market a ”ferment your own” enzyme product which would permit arbitrary enzyme fermentation and purification in usefully pure form, I designed a novel agar-based chromatographic solution and tested it with transgenic fluorescent proteins. While proper function of PySplicer software was successfully demonstrated by vivid fluorescence (a remarkable achievement for wild-type GFP), the agarose-binding protien proved unamenable to protein fusion and did not function as required after several rounds of prototyping and expert consultation.

2014 **IndieBB (2)** Glowbiotics

Designed a concept DNA vector that would enable antibiotic-free selection in *E.coli* using Colicin-V mediated allelopathic selection. Planned further experiments upon the vector would have attempted to replace the transport cassettes of the Colicin V operon with periplasmic disruption proteins, which would have yielded a lower DNA footprint than extant selection cassettes. Regrettably, funding was not raised for this project, though it is instead being implemented as an iGEM project by a New York biotechnology lab.

Communication Events

2014 **Stem Cells, Biohacking, GM & the future of humans** — Pint of Science, Dublin
Participated in a Panel Discussion on Biotechnology, Agriculture, Bioethics & Human Enhancement with positive responses from a mixed-background audience.

2013 **Bringing Biotechnology Into the Home** — TEDx Dublin 2013
Presented a vision for ubiquitous synthetic biology as a facet of a future everyday life at an event attended by thousands and viewed and favoured by over ten thousand more since.

2012 **Enter Bio-Hacking** — PICNIC Conference, Amsterdam
Introduced the rapidly changing field of ”do-it-yourself” biotechnology at a technology and design conference in a prominent waterfront theatre in Amsterdam.

Media Appearances

2012 **Doing Biotech in my Bedroom** — MIT Technology Review
Coverage of a lab I established in a domestic setting and my work in enabling low-cost synthetic biology. (NB: There was never a bed in the lab)

2012 **For Bio-hackers, Lab Work Often Begins at Home** — New York Times
Headed a story on DIY-biotechnology with reference to my work designing low-cost tools and methods.

2013 **Biohackers - Les Bricoleurs d'ADN** — Le Monde (Online)
Presented alongside other leading figures in Lean Biotech in an interactive online format which encouraged viewers to ”ask” questions and receive pre-recorded responses. Initially available to the public, but since paywalled.