Anurag Arnab

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Summary

I am a first-year PhD student interested in the fields of Computer Vision and Machine Learning. My current research focuses on integrating graphical models into deep neural networks in the context of Computer Vision problems such as Scene Understanding. I enjoy solving challenging problems and envisage putting my artificial intelligence and software engineering skills to use in a manner that is beneficial to society.

Education

2015–present **DPhil in Information Engineering (Computer Vision)**, *University of Oxford*, UK.
Research currently focuses on Deep Learning and integrating Probabilistic Graphical Models into deep architectures. I have published recent ECCV and BMVC conference papers about this line of work and its applications to Semantic and Instance Segmentation respectively.
Supervisor: Professor Philip Torr

2011–2014 **BSc (Eng) Electrical and Computer Engineering**, *University of Cape Town*, South Africa.
Graduated as the top student in the entire Engineering faculty comprising of approximately 500 students. Undergraduate thesis on Biometric Vein Recognition advised by Dr. Andrew van der Byl.

Publications

Anurag Arnab, Sadeep Jayasumana, Shuai Zheng, Philip H.S Torr. Higher Order Conditional Random Fields in Deep Neural Networks. *European Conference on Computer Vision (ECCV)*, 2016

Anurag Arnab, Philip H.S Torr. Bottom-up Instance Segmentation using Deep Higher Order CRFs. *British Machine Vision Conference (BMVC)*, 2016

Anurag Arnab, Michael Sapienza, Stuart Golodetz, Julien Valentin, Ondrej Miksik, Shahram Izadi, Philip H.S. Torr. Joint Object-Material Category Segmentation from Audio-Visual Cues. *BMVC*, 2015

Stuart Golodetz, Michael Sapienza, Julien Valentin, Vibhav Vineet, Ming-Ming Cheng, **Anurag Arnab**, Victor Adrian Prisacariu, Olaf Kaehler, Carl Yuheng Ren, David W. Murray, Shahram Izadi, Philip H.S. Torr. SemanticPaint: A Framework for the Interactive Segmentation of 3D Scenes. *arXiv*, 2015 (technical report)

Stuart Golodetz, Michael Sapienza, Julien Valentin, Vibhav Vineet, Ming-Ming Cheng, Victor Adrian Prisacariu, Olaf Kaehler, Carl Yuheng Ren, **Anurag Arnab**, Stephen Hicks, David W. Murray, Shahram Izadi, Philip H.S. Torr. SemanticPaint: Interactive Segmentation and Learning of 3D Worlds. *ACM SIGGRAPH 2015 Emerging Technologies*, 2015 (live demo)

Awards and Honours

- **Clarendon Scholarship**, 2015-2018. Awarded to only two graduate students applying to the Department of Engineering Science at Oxford and covers fees and living costs for three years.
- **Travel Grants** I have been awarded travel grants to the following Summer Schools:
  - Machine Learning Summer School, May 2016. Càdiz, Spain
  - Integrating Vision and Language Summer School, March 2016. Malta
- **Engineering Council of South Africa Medal of Merit**, 2014. Awarded to the best student graduating with the degree of BSc (Eng).
- **ESKOM Award**, 2014. Awarded to the best Engineering graduate at the University of Cape Town over the 4-year degree curriculum, out of approximately 500 students.

- **City of Cape Town Corporation Silver Medal**, 2013. Best engineering student across third year, out of approximately 500 students.
- **City of Cape Town Corporation Bronze Medal**, 2012. Best engineering student across second year, out of approximately 500 students.
- **Electrical and Computer Engineering Class Medal**, Best student in degree programme in each year of study from 2011 through 2014.
- **Klaus-Jurgen Bathé Scholarship**, 2013. Awarded to three students in the final two years of study (out of about 1000 students) who "show evidence of high intellectual power and commitment to the achievement of excellence in the field of Engineering."
- **Top 3 in IBM Master the Mainframe Contest**, 2013. One of the top three entrants from South Africa in the final round.
- **BSG Prize**, 2012. Best second-year Computer Science student.
- **Class Medals** Awarded for achieving the highest marks in an individual course. Obtained seven medals in the following courses:
  - Linear Algebra and Differential Equations *class size of about 500 students*
  - Operating Systems and C++ *class size of about 60*
  - Introductions to Concurrency, Computer Architecture and Human-Computer Interaction *class size of about 150*
  - Object Oriented Programming *class size of about 300*
  - Digital Systems *class size of about 30*
  - Electrical Engineering I *class size of about 160*
  - Africa: Culture, Identity and Globalisation *class size of about 160*

Invited Talks

October 2016 **ECCV Tutorial: Deep Learning Meets Model Optimization and Statistical Inference** , *Amsterdam*, Netherlands.
I will present my ECCV 2016 paper about Higher Order Conditional Random Fields in Deep Neural Networks, as part of an invited talk delivered jointly with other members of my research group.

February 2016 **Vision and Learning Seminar**, *Online*, Nankai University, China.
Presented my BMVC 2015 paper which incorporated audio information into semantic segmentation, as part of a larger presentation of our research group's work.

November 2015 **Centre for Vision, Speech and Signal Processing**, *University of Surrey*, United Kingdom.
Invited to give a seminar about my BMVC 2015 paper which incorporated audio information into semantic segmentation.

Computer Vision Lab, *TU Dresden*, Germany.
Invited to give a talk about my recent work in combining Convolutional Neural Networks and Conditional Random Fields into a single, end-to-end trainable network.

Relevant Experience

Research

January - July 2015 **Visiting Intern**, *Torr Vision Group*, University of Oxford, United Kingdom.
Visiting intern at Prof. Philip Torr's research group where I am now a graduate student. My project on incorporating audio information into semantic segmentation was published at the BMVC conference. Furthermore, I was involved in the "Semantic Paint" interactive 3D reconstruction and segmentation project which was demonstrated at SIGGRAPH.

July - November 2014 **Undergraduate thesis - Biometric Vein Recognition**, *University of Cape Town*, South Africa.
Developed algorithms to identify individuals according to the unique patterns of the veins in their fingers. One of the proposed methods outperformed recently published work using the same SDUMLA-HMT database. A conference paper about this method was accepted, but I could not attend the conference (organised by the Pattern Recognition Association of South Africa) and the paper was withdrawn.

January 2014 **Research Assistant**, *Council for Scientific and Industrial Research*, South Africa.
Worked on a project to develop a fingerprint scanner which is more robust and accurate as it matches the entire three-dimensional volume of the finger as opposed to just the surface. Developed a volume renderer – software which creates 3D models from multiple 2D images of the same object.

Industry

June - July 2013 **Software Engineering Intern**, *ACI Worldwide*, South Africa.
Developed a system which identified dependencies between products in the code base by analysing the source code. This system could also integrate with other data sources used by the company for further analytics.

July, December 2012 **Participant in Cluster Computing Competition**, *Centre for High Performance Computing*, South Africa.
Leader of a group tasked with designing and benchmarking a computing cluster built on a budget of R200 000 ($24 000 / £15 000). The team's cluster was adjudged to have the best design.

June - July 2012 **Web Developer Intern**, *RetroMod Technologies*, South Africa.
Developed websites and designed the database for a wireless-mesh project at a local start-up.

Teaching

2013 - present **Developer**, *Hyperion Development*, South Africa.
Member of a student-run organisation which provides charitable teaching and training in computer programming. This initiative addresses the problem that the majority of South African high schools do not teach programming. Primary role is developing the content of a free online course teaching Python, and also tutoring this course. Over 2000 South African students have taken this course, and it is funded by grants from the Python Software Foundation, among other sponsors. For more information, please refer to `http://www.hyperiondev.com` (also part of the team currently developing and maintaining the website)

February 2012 - May 2014 **Tutor**, *University of Cape Town*, South Africa.
Tutored first- and second-year Signal Processing courses in 2014. Tutored first- and second-year Computer Science courses in 2012 and 2013 respectively. Duties included marking class tests and assignments, and assisting in laboratory sessions.

Programming Competencies

Fluent in C++, Python, Java, MATLAB

Competent in C, Lua, C#, PHP, SQL, HTML, Javascript, CSS, Assembly (ARM and Motorola HCS08), VHDL, Verilog

Libraries Used Caffe, Torch, OpenCV, Boost, NumPy, scikit-learn, Qt, Django, Android, .NET, VLFeat, OpenGL, Bootstrap

Github `https://github.com/hmph`

Societies and Service

2011 - present **Badminton Club**, Universities of Cape Town and Oxford.
Regular member of badminton clubs at universities of Cape Town and Oxford.

2012 - 2014 **Writer**, *Varsity Newspaper*, University of Cape Town.
Writer for the "Opinions" and "Sports" sections of the student-run university newspaper.

2011 - 2014 **Green Campus Initiative**, University of Cape Town.
Promoted carpooling at the university by creating and maintaining a lift-matching website.

2009 **Global Warming Website**.
Created a website to spread awareness about Global Warming for the Oracle Thinkquest International Website Competition. It was adjudged to be the best entry from South Africa.

Languages

English Fluent *Lived in South Africa since childhood. Awarded English subject prize in secondary school.*

Bengali Fluent *Native speaker*

Afrikaans Proficient *Studied for 9 years in school*