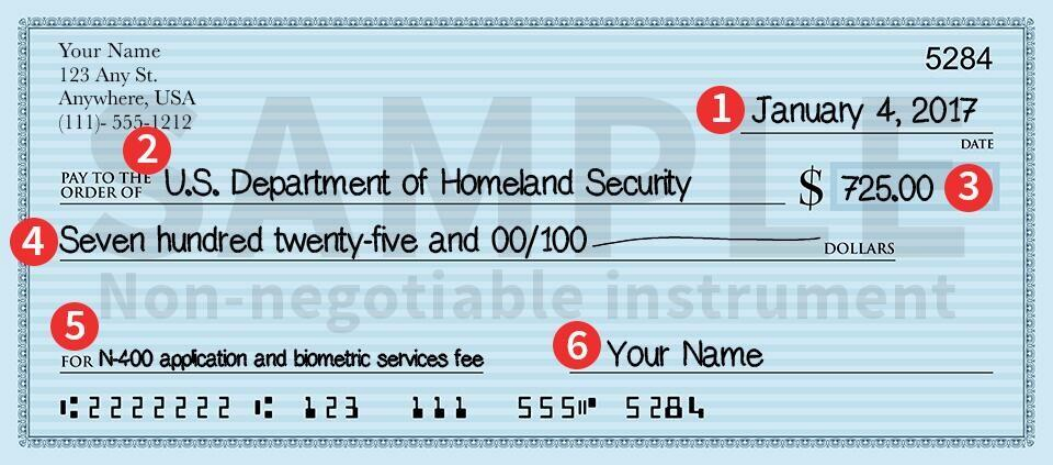

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Initial Evidence in Support of the I-140 Immigrant Petition

Petitioner and Beneficiary:	Razvan Marinescu
Classification Sought:	Employment-Based Immigration, First Preference Extraordinary Ability in Science (EB-1A). Sec. 203(b)(1) INA [8 U.S.C. 1153].

To whom it may concern,

This letter is respectfully submitted in support of the petition of Dr. Yu Wang for classification as a qualified immigrant under the first preference employment immigration for Aliens of Extraordinary Ability pursuant to section 203(b)(1)(A) of the Immigration and Nationality Act ("the Act"). This evidence shows that Dr. Marinescu is an alien of extraordinary ability in the sciences, specifically in Biostatistics and Computational Biology, who sustained national and international acclaim and his achievements have been recognized in the field of expertise. More precisely, this letter provides evidence that:

1. Dr. Wang satisfies five [three is minimum, but if you can, do an extra one to be on the safe side] of ten criteria listed in 8 CFR, Section 204.5(h)(3), namely:
   - Evidence of Dr. Wang's original scientific and scholarly contributions of major significance in the field. (section 2.1)
   - Dr. Wang's authorship of scholarly articles in the field in professional media. (section 2.2)
   - Evidence of receipt of lesser internationally recognized awards for excellence in the field of endeavor. (section **??**)
   - Participation of Dr. Wang as a judge of the work of others in the field of Biostatistics and Computational Biology (section 2.3)
   - Evidence that Dr. Wang has performed in a critical role for organizations that have a distinguished reputation. (section 2.4)
2. Dr. Wang reached a level of expertise indicating that he is one of that small percentage who have risen to the very top of the field of Biostatistics and Computational Biology – section 3.1.
3. Dr. Wang sustained national or international acclaim and that his achievements have been recognized in the field of Biostatistics and Computational Biology – section 3.2.

Pursuant to 8 CFR, Section 204.5(h)(1), Dr. Wang may file an I-140 visa petition for classification under Section 203(b)(1)(A) of the Act as an alien of extraordinary ability in the sciences on his own behalf.

Pursuant to 8 CFR, Section 204.5(h)(5), neither an offer for employment in the United States nor a labor certification is required for this classification.

1 Summary of Dr. Wang's achievements and qualifications

Dr. Wang is a Research Scientist in Division of Biostatistics(DB) at the Medical College of Wisconsin (MCW) [Exhibit 24]. Dr. Wang joined MCW since August 2019, he first completed his PhD in Biostatistics and then became a full-time researcher. His research focuses on Artificial Intelligence (AI) for Biology, with a strong focus on Time-to-event, Whole Genome Sequence(WGS), and single-cell RNA sequencing(scRNA-seq). Before coming to the United States, he has lived in the United Kingdom for 8 years, where he pursued his undergraduate degree at Imperial College London and PhD at University College London, two leading universities worldwide [Exhibit 1] [Exhibit 23]. Dr. Wang graduated with First Class Honours in Computer Science at Imperial College London [Exhibit 23].

Dr. Wang works on Artificial Intelligence (AI) for Medicine, which involves creating state-of-the-art algorithms for understanding, preventing, and solving human diseases, thus enabling the highest quality healthcare for everyone. Artificial Intelligence is predicted to have a tremendous impact in healthcare, from enabling better decision making, to making medical scans and data of much better quality, faster and cheaper. Dr. Wang's work in particular focuses on creating AI algorithms that perform medical diagnoses with unprecedented accuracy, and as early as possible, and AI algorithms that map the temporal progression of diseases. Dr. Wang has worked for more than 6 years on building Artificial Intelligence algorithms for predicting the progression of neurodegenerative diseases such as Alzheimer's disease, currently affecting more than 50 million people worldwide, as well as other neurodegenerative diseases such as Posterior Cortical Atrophy, Multiple Sclerosis and Frontotemporal dementia.

Dr. Wang has made contributions of major significance to the field of Artificial Intelligence in Medicine. He performed the first comprehensive study for estimating the progression of Posterior Cortical Atrophy (section 2.1.1), a neurodegenerative syndrome affecting around 2.5 million people worldwide. He also created TADPOLE (section 2.1.2), the most widely-used challenge and benchmark for algorithms to predict Alzheimer's disease, which had a major impact not just in academia, but also in the biopharmaceutical industry, due to fundamental implications on how Alzheimer's patients are selected for clinical trials. Dr. Wang also created DIVE (section 2.1.3), a computational model that estimates the progression of Alzheimer's disease, for which he was nominated as runner-up for the Francois Erbsmann prize at the International Conference on Information Processing in Medical Imaging (IPMI). Dr. Wang also made contributions of major significance on modelling the progression of Multiple Sclerosis and Frontotemporal dementia (section 2.1.4), having co-authored highly influential articles with more than 100 citations each.

Dr. Wang has authored 25 peer-reviewed scientific articles (12 as first author) that have been published in the top journals in the Artificial Intelligence and medical imaging fields (section 2.2). The articles Dr. Wang authored have gathered more than 485 citations as of June 2021 [Exhibit 2], and have been cited 154 times in the last 6 months alone, showing an exponential increase in the impact of his work. Dr. Wang's articles have been published in leading journals and conferences in the field, and have gathered significantly more citations than the articles of his peers (section 2.2.3).

Dr. Wang has also been a judge for the work of others, having been a reviewer on more than 30 scientific

articles in 11 leading journals and conferences in the fields of medical Artificial Intelligence and related disciplines (section 2.3).

Dr. Wang has been a leader of two distinguished organizations. First, he was the President of the MIT Postdoctoral Association (section 2.4.1), representing all postdoctoral researchers at MIT, currently numbering 1400, in matters related to the MIT administration as well as in the planning of career events for postdoctoral researchers. Under Dr. Wang's leadership, the Postdoctoral Association started advocacy efforts for better housing for postdocs, increased childcare support, and improved career development programs, which impacted all postdoctoral researchers at MIT. As the President of the MIT Postdoctoral Association, Dr. Wang was also on the hiring committee of the MIT Institute Community and Equity Officer (ICEO), a key role in the university that reports straight to the provost. Secondly, Dr. Wang also organized TADPOLE (section 2.4.2), currently the leading benchmark worldwide on AI models for predicting Alzheimer's disease. TADPOLE had a significant impact on Alzheimer's disease research, both in academia as well as the biopharmaceutical sector, and brought together a community of thirty-three international teams to create state-of-the-art AI models.

As evidenced by seven recommendation letters from distinguished professors within academia and managers in the biotechnology industry, his 25 scientific publications and 30 peer-reviews, as well as his leadership roles, Dr. Wang has raised to the very top of the field of medical AI (section 3.1). Dr. Wang has further sustained this performance, as evidenced by the increasing number of citations obtained recently (154 in the last 6 months alone), and the four invited talks he gave in the last 12 months at prestigious universities in North America: Harvard University, Stanford University, University of British Columbia and University of California Santa Cruz. In addition, Dr. Wang's research achievements have recently been documented in *Adevarul*, one of the most widely-circulated and trusted newspapers in Romania [Exhibit 18].

2 Proof of Dr. Wang's Extraordinary Ability

2.1 Evidence of original scientific, scholarly, artistic, athletic, or business-related contributions of major significance to the field

2.1.1 Evidence of original scientific contribution: First comprehensive study estimating the progression of Posterior Cortical Atrophy

Dr. Wang performed the first comprehensive study for estimating the progression of Posterior Cortical Atrophy, a neurodegenerative disease that affects the posterior part of the brain. While previous studies have only qualitatively analysed isolated case reports, Dr. Wang analysed the first comprehensive population of 102 patients with Posterior Cortical Atrophy, and was the first to run computational models to map the progression of the disease over time. The article, published in the journal Brain in 2019, has already been cited 37 times as of June 2021 [Exhibit 10].

"*Dr. Marinescu has further made landmark contributions to the study of Posterior Cortical Atrophy, a variant of Alzheimer's disease that affects the visual cortex. Compared to typical Alzheimer's disease,*

the progression of Posterior Cortical Atrophy was until recently poorly understood. Dr. Marinescu, through his scientific article published in the journal Brain as well as his PhD thesis, elucidated the temporal progression of Posterior Cortical Atrophy, and showed that it is indeed distinct from that of Alzheimer's disease. He further analysed the progression patterns in three different subgroups of Posterior Cortical Atrophy with different clinical presentations, and showed that these subgroups again have different progression profiles of brain atrophy. These contributions are fundamental for clinical trials in Posterior Cortical Atrophy, and will help the management of all patients suffering from Posterior Cortical Atrophy, currently believed to number approximately 2.5 million people worldwide." (GC, Professor of Neuroradiology, University of ABC)

"*Dr. Marinescu, in collaboration with Dr. Firth and Dr. Primativo, authored the first comprehensive longitudinal study on the progression of Posterior Cortical Atrophy. In this landmark study, Dr. Marinescu used Artificial Intelligence models to estimate the evolution of brain atrophy in the largest study population of subjects of Posterior Cortical Atrophy to date. He elucidated precisely which brain regions are affected, and in which exact temporal order, which was until then poorly understood. The article, while recently published in 2019, has already been cited more than 32 times. As a leading expert in Posterior Cortical Atrophy, I can certify that this study was of paramount importance for the field: it provided the very first glimpse into the temporal evolution of Posterior Cortical Atrophy, which is necessary for understanding its fundamental mechanisms and for running future clinical trials. In addition, given that most subjects with Posterior Cortical Atrophy are given drug treatments normally given for typical Alzheimer's disease, this study provided strong evidence that Posterior Cortical Atrophy is likely to be a different disease that will require specialised drug treatments compared to typical Alzheimer's disease.*" (TF, Professor of Neuropsychology, XYZ)

In addition, in his PhD thesis, Dr. Marinescu has also extensively studied the evolution of subgroups of patients with Posterior Cortical Atrophy, the first such study of this kind [Exhibit 10].

"*In his PhD thesis, as well as the article submitted to the Alzheimer's Association International Conference (AAIC), Dr. Marinescu was among the very first to study the evolution of brain pathology in different subgroups within Posterior Cortical Atrophy. The work done by Dr. Marinescu proved that different clinical symptoms indeed correspond to different brain regions affected. This work is of major importance for future personalized medicine, as drugs and therapies tailored to specific individuals or subgroups will be more effective and have fewer side effects.* " (TF, Professor of Neuropsychology, XYZ)

2.1.2 Evidence of original scientific contribution: Created the most widely-used challenge and benchmark for algorithms to predict Alzheimer's disease

Dr. Wang has created "The Alzheimer's Disease Prediction Of Longitudinal Evolution" (TADPOLE) Challenge, where 33 international teams from both academia and industry built state-of-the-art algorithms to predict the evolution of Alzheimer's disease. Dr. Wang not only organised challenge, but also evaluated all submissions from all teams, analysed the final results, and presented them in three scientific articles [Exhibit 11], as well as at the most prestigious international conferences. This work was of major significance and impact in the research community, as can be seen by the 79 citations obtained

by the three TADPOLE articles so far [Exhibit 11].

"*Dr. Marinescu also ran and analyzed the results of TADPOLE Challenge, an international competition that evaluated algorithms for predicting the progression of individuals at risk of Alzheimer's disease. While previous research algorithms were all tested on different datasets or subsets of the data, this made their comparison extremely difficult. Under Dr. Marinescu's leadership, an entire research community was brought together to focus on a single task. In addition, the study was extremely unique, because it was completely blind to the evaluation data, which did not exist at the time the predictions were made as it was acquired afterwards. This made the TADPOLE study completely unbiased, and the only one in our research community to be entirely prospective.*" (QR, Professor of EECS, MIT)

In addition, Dr. Wang's TADPOLE work has been recognized by many prominent researchers who have not directly collaborated with him.

"*I have never met Dr. Marinescu in person, but I am aware of his original scientific contributions to the field of medical artificial intelligence. I have first come in contact with his work in 2017, when my research team decided to participate in TADPOLE, the international challenge Dr. Marinescu organized which aimed to evaluate algorithms that predict the progression of Alzheimer's disease. TADPOLE is a one-of-a-kind challenge and benchmark for comparing a variety of algorithms and methods for the challenging task of predicting Alzheimer's disease, a key neurodegenerative disease affecting millions of people worldwide. While previous algorithms in our research field were all tested on different datasets and with different target variables to be predicted, TADPOLE created a standardized evaluation framework which made all algorithms' performance comparable. Thirty-three international teams from nine different countries, with approximately three members each, participated in the challenge, and submitted a total of ninety-two prediction algorithms.*" (UZ, Professor of Electrical and Computer Engineering, Univ A)

The impact of TADPOLE has been significant and can potentially impact millions of patients with Alzheimer's disease worldwide, and helped identify what are the best AI prediction methods in the field:

"*Through TADPOLE, Dr. Marinescu made a huge scientific contribution to our research field. First, it helped establish how well and how early we can predict Alzheimer's disease with computational algorithms, what are the state-of-the-art algorithms for Alzheimer's disease prediction, and what types of input data are most informative for such predictions. Secondly, Alzheimer's disease is a devastating disease worldwide, with currently more than 50 million people affected, and having associated costs of approximately $100 billion in the United States alone. The ability to detect the disease early, using such AI algorithms, can improve the healthcare management of millions of people worldwide, and also lower the economic costs and caregiver efforts for managing Alzheimer's disease patients.*" (UZ, Professor of Electrical and Computer Engineering, Univ A)

"*In addition, the contribution of TADPOLE towards the field was immense. In particular, the most surprising result was that while the models could predict the clinical diagnosis and measures from Magnetic Resonance Imaging, they could not reliably predict cognitive scores that are routinely used in clinical trials of Alzheimer's disease. This finding has important implications for clinical trials, and also highly impacted the field: many researchers are now working on improving the predictions models for cognitive tests.*" (GC, Professor of Neuroradiology, University of ABC)

"*The impact of the TADPOLE competition in Alzheimer's disease prediction research cannot be overstated: around 30-40 international teams participated in the competition from both academia and the biotech. industry, and it entirely reshaped the field regarding what are the best AI methods for predicting such a disease.*" (DI, Senior Director of XYZ, Company ABC, USA)

"*The challenge received a lot of interest from researchers, media and institutions around the world: more than 30 international teams participated with almost 100 different prediction models, it was featured in the media, and received sponsorship from the three main Alzheimer's disease charities Alzheimer's Association, The Alzheimer's Society, and Alzheimer's Research UK.* " (GC, Professor of Neuroradiology, University of ABC)

TADPOLE had a major influence not just within academia, but also in the pharmaceutical industry. XX, a major biopharmaceutical company, participated in the challenge, while YY, another major biopharmaceutical company, has closely followed the work:

"*I have first heard of Dr. Marinescu's work in 2017, when our team at XX decided to participate in the TADPOLE Challenge, which he organised during his PhD at University College London. As part of the challenge, we had to create an algorithm that could automatically predict which subjects would develop Alzheimer's disease in the future. This task was well aligned with our objectives of building computational AI models for early diagnosis of diseases such as Alzheimer's disease. While we had many years of experience with such algorithms, it was not an easy task due to the unfamiliarity with the data. Eventually, we managed to create a good algorithm for making accurate predictions [...].*" (DI, Senior Director of XYZ, Company ABC, USA)

"*Another influential work by Dr. Marinescu that we have been paying very close attention is the TADPOLE Competition, which compares algorithms at predicting the progression of individuals at risk of Alzheimer's disease. These algorithms are highly useful towards identifying the most suitable patients that can go into our clinical trials, i.e. those that will benefit the most from the drug treatments. This solves one key issue we often face in clinical trials, that of cohort diversity due to different underlying genetics and pathology, which often obscures treatment effects. The computational models from the TADPOLE Challenge can help us select homogeneous groups of patients, thereby increasing the treatment effects in drug trials.*" (TI, Vice President of M, Company XYZ, USA)

The results of TADPOLE have also been featured in the media, such as the article from Alzforum [Exhibit 11]. Alzforum is a website founded in 1996 that brings together a team of specialists in science writing, and presents to the wider public the latest research on Alzheimer's disease [Exhibit 11].

"*Results are in for the TADPOLE Challenge – a prize contest that invited researchers to come up with their own ways of predicting dementia symptoms in participants enrolled in the Alzheimer's Disease Neuroimaging Initiative (ADNI). In a live webinar on June 14, organizers announced who came out ahead. Contestants had submitted computer code to forecast the clinical status, cognitive scores, and/or imaging characteristics of ADNI3 participants. Once submissions were in, the data were collected and results tabulated. The best methods garnered prize money in the amount of £30,000, donated by the Alzheimer's Society in London, Alzheimer's Research U.K., and the Alzheimer's Association.*" (Gwyneth Dickey Zakaib, Alzforum, 19 Jun 2019)

2.1.3 Evidence of original scientific contribution: Created DIVE, a computational model estimating the progression of Alzheimer's disease

Dr. Wang has also published "Data-driven Inference of Vertexwise Evolution" (DIVE), a model for estimating the progression of brain pathology in Alzheimer's disease. His work was nominated as runner-up for the Francois Erbsmann prize at the Information Processing in Medical Imaging (IPMI) conference. The Francois Erbsmann prize is a prize given to one person every year, for outstanding contributions to the field, and is the only prize awarded by the IPMI conference.

"*In his pioneering work at the IPMI conference, he [Dr. Marinescu] proposed DIVE, a model for predicting the progression of Alzheimer's disease at each location on the brain. While previous progression models used a very simplistic assumption of averaging measurements of brain pathology across entire brain regions, this did not allow one to see fine-grained patterns of pathology that affect small regions in the brain. As an analogy, imagine a world map showing the population density in each country. While that is very informative in itself, it cannot give information about the variation of density within a particular country. Dr. Marinescu's contribution, translated to this world map, enabled one to measure the population density at the resolution of small cities and towns, and in addition, also measure population trends over time. However, solving this problem for the human brain was extremely difficult computationally and mathematically due to the fact that there are more than 100,000 3D pixels in a single brain image, and such a study required thousands of images to be analyzed together. To overcome these fundamental limitations, his insight was to use techniques from unsupervised learning to cluster trajectories based on their similarity. This creative solution opened up the possibility of studying brain diseases at a much better resolution than previously possible, and allowed neuroscientists to significantly improve their understanding of mechanisms underpinning brain diseases.*" (QR, Professor of EECS, MIT)

The DIVE model had a substantial impact in the field. The two articles [Exhibit 12] published by Dr. Wang in prestigious publication venues, were cited more than 44 times as of June 2021 and resulted in further developments by research groups around the world.

"*The DIVE model was a highly original contribution to the field and was very well-received at the Information Processing for Medical Imaging conference (IPMI), having been nominated for the Francois Erbsmann prize. As an expert in the field, I can attest that IPMI is one of the leading venues in medical image analysis and medical artificial intelligence, and only outstanding contributions are considered for the Francois Erbsmann prize at IPMI. The paper has since gathered 23 citations, and a follow-up model that builds on DIVE has already been implemented by the research team at INRIA, France. In addition, Dr. Marinescu's DIVE article was published in the NeuroImage journal. As the editor of the journal myself, I can confirm that the acceptance standards are very high, with only the best articles being accepted for publication.*" (UZ, Professor of Electrical and Computer Engineering, Univ A)

"*The DIVE model can be used not only to predict the future evolution of Alzheimer's disease subjects, but also to identify new Alzheimer's disease biomarkers that can be used to diagnose the disease and monitor its progression. My team at XX has been working for several years on developing novel biomarkers of Alzheimer's disease, and I can confirm that Dr. Marinescu's work is of fundamental importance for the research field, and had a significant impact on future development of AI prediction models for Alzheimer's disease. It was for instance cited more than 24 times, while the precursor to DIVE, also by Dr. Marinescu[2], was cited more than 14 times so far.*" (DI, Senior Director of XYZ, Company ABC,

USA)

2.1.4 Evidence of original scientific contribution: Disease progression modelling of Multiple Sclerosis and Frontotemporal dementia

Dr. Wang co-authored a number of influential publications which used computational models to study Multiple Sclerosis and Frontotemporal dementia, two devastating neurodegenerative diseases affecting several million people worldwide. For Multiple Sclerosis, Dr. Marinescu, in collaboration with Dr. Eshaghi, authored the largest study [Exhibit 13] to date on the progression of Multiple Sclerosis, which revealed that the brain pathology spreads in a particular sequence that they closely described. This publication received more than 106 citations to date, and represents a landmark study in the field.

"*In another landmark study Dr. Marinescu co-authored with Dr. Eshaghi, they applied such disease progression models on the largest cohort to date of subjects with Multiple Sclerosis, and found that the brain gray matter is affected in a specific sequence of events that they described. The publications are both well cited, and their models widely used in the research community, with [...] the Multiple Sclerosis study already receiving more than 104 citations. As one of the world experts in Multiple Sclerosis and Alzheimer's disease, I can confirm that such models are of crucial importance for identifying the right subjects for clinical trials, and I am aware that pharmaceutical companies are already using their models for the analysis of their imaging data in Alzheimer's disease and Multiple Sclerosis drug trials.*" (GC, Professor of Neuroradiology, University of ABC)

"*Dr. Marinescu, together with Dr. Eshaghi, also authored a prominent study on the evolution of Multiple Sclerosis in the largest cohort to date (more than 3000 subjects), which demonstrated that the brain regions in Multiple Sclerosis become affected in a precise sequence that they mapped. Dr. Marinescu has also recently co-authored another study in the Elife journal on the role that brain neural connections play in Multiple Sclerosis and Alzheimer's disease, as well as another publication on the progression of Huntington's disease, a neurodegenerative disease affecting the motor cortex. All these publications highlight the wide remit of Dr. Marinescu's AI models, in particular the disease progression models, that can be applied to many different brain diseases in order to clarify and understand their progression over time. Given the millions of people around the world affected by these diseases, Dr. Marinescu's work is of large impact to society.*" (TF, Professor of Neuropsychology, XYZ)

In addition, Dr. Wang's modelling approach was adopted by XYZ, a large pharmaceutical company, for their Multiple Sclerosis clinical trials. This highlights the impact this work had not just within academia, but also in the biopharmaceutical industry.

"*... Dr. Marinescu has also co-authored another high-profile article on mapping the evolution of neurodegeneration in Multiple Sclerosis using disease progression models. We at XX have been extremely interested in the modelling approach used by Dr. Marinescu, and have used it for our brain imaging data in Multiple Sclerosis. I should highlight that such models are critical for our 5 clinical trials in Alzheimer's disease, as well as our 2 clinical trials in Multiple Sclerosis, as they can predict the disease evolution of individual subjects undergoing the clinical trials, help select the most suitable subjects for going into the trial, and help select the right target measure for evaluating the drug effects. Given the potential to impact all our clinical trials, that incur costs in the order of millions of dollars, our Artificial*

Intelligence team has implemented and built on Dr. Marinescu's models." (TI, Vice President of M, Company XYZ, USA)

Dr. Marinescu, alongside Dr. Young, has also authored the Subtype and Stage Inference, a novel computational model that revealed previously unknown variability in Frontotemporal dementia, a brain disease that affects the frontal and temporal lobes. This study [Exhibit 13], published in Nature Communications, has been of major impact in the field, having been cited 101 times as of June 2021.

"*Dr. Marinescu has also authored other prominent works on disease progression models. The "SuStaIn" model, published in the Nature Communications journal, is a novel technique that can find, within a disease population, multiple sub-populations that progress with different disease patterns. The SuStaIn model discovered that, in Frontotemporal Dementia, the patients with a specific mutation (C9orf72) were actually composed of two distinct groups, instead of a single uniform group as it was believed until that time.*" (UZ, Professor of Electrical and Computer Engineering, Univ A)

"*Dr. Marinescu has done outstanding work on brain diseases other than Alzheimer's [disease] and Posterior Cortical Atrophy. His seminal work on the Subtype and Stage Inference (SuStaIn) model has revealed the precise variability in brain pathology in patients with Frontotemporal dementia (FTD), and importantly, found that the patients with the C9orf72 mutation are more diverse than previously thought.*" (TF, Professor of Neuropsychology, XYZ)

Finally, this line of work, as emphasized by Dr. XX, can have tremendous impact on US healthcare, given that millions of people are affected by Alzheimer's disease and the lack of suitable treatments.

"*Dr. Marinescu is also very well-known for his work on disease progression models, a specific class of medical AI models which predict not just the diagnosis of a particular patient, but their entire future progression. He worked on several major research projects in this line of research, such as a key study of Multiple Sclerosis, which gathered more than 106 citations so far, and the SuStaIn model, which gathered more than 85 citations so far, and characterised the disease variability in both Alzheimer's disease and Frontotemporal Dementia. Given the huge burden of such diseases, affecting more than 3 million people just in the United States alone, and the lack of suitable treatments, the work of Dr. Marinescu is of paramount importance for healthcare in the US and worldwide, and can have even more impact in the future.*" (DI, Senior Director of XYZ, Company ABC, USA)

2.2 Evidence of authorship of scholarly articles in professional or major trade publications or other major media

2.2.1 Dr. Wang has published 25 scientific articles in the field of Medical Artificial Intelligence

As evidenced in Dr. Wang's Curriculum Vitae [Exhibit 1] and in his Google Scholar profile [Exhibit 2], Dr. Wang has so far authored more than 25 scientific articles (12 as first author), which have together gathered more than 485 citations [Exhibit 2] as of April 2021. Three of the papers he authored have received more than 20 citations in 2020 alone, comparable to top 100 papers in the field of medical artificial intelligence [Exhibit 17].

The most important of Dr. Wang's publications, alongside their impact in the field, have been presented in detail in section 2.1 and are shown in [Exhibit 10], [Exhibit 11], [Exhibit 12] and [Exhibit 13]. Other important publications not described there also include Disease Knowledge Transfer, an AI model that can transfer information from common neurodegenerative diseases such as Alzheimer's disease to rarer diseases such as Posterior Cortical Atrophy [Exhibit 25]. BrainPainter, an article authored by Dr. Wang introducing a software to visualize brain images, has already been cited 14 times since it's publication in November 2019 [Exhibit 25]. With collaborators Dr. Alexandra Young and Dr. Peter Wijeratne at University College London, Dr. Wang co-authored novel disease progression models for Alzheimer's disease as well as Huntington's disease, which have each been cited more than 23 times since their publication [Exhibit 25]. In addition, Dr. Wang's PhD thesis contains work on 5 research directions that have been published in more than 7 research articles at journals and conferences in the field [Exhibit 10].

2.2.2 Dr. Wang's publications have been published in the leading journals and conferences in his field

Dr. Wang's scientific articles have been published in the leading venues in Artificial Intelligence and Medicine, which include:

- Brain: top neuroscience and neurology journal, with impact factor of 11.3, has been in circulation since 1878. Dr. Wang authored two articles in Brain [Exhibit 1].
- Nature Communications: leading journal with a wide life-science remit, impact factor of 12.1. Dr. Wang authored one article in Nature Communications [Exhibit 1].
- NeuroImage: the top journal for neuroimaging studies, with impact factor of 5.9. Dr. Wang authored one article in NeuroImage [Exhibit 1].
- Information Processing in Medical Imaging (IPMI): major conference on medical imaging, also the oldest, having first been organised in 1969. Dr. Wang authored one article in IPMI [Exhibit 1].
- Medical Image Computing and Computer Assisted Surgery (MICCAI): Largest venue in Artificial Intelligence for Medicine, with more than 1,700 delegates and 540 research articles presented in 2019. It is ranked #1 in the Medical Informatics category [Exhibit 14]. Dr. Wang authored four articles in MICCAI and its workshops [Exhibit 1].
- Alzheimer's Association International Conference: the largest conference on Alzheimer's disease, with audience ranging from researchers in fundamental science, biopharmaceutical companies, and clinical practitioners. Dr. Wang authored four articles in the AAIC conference [Exhibit 1].

Dr. XX and Prof. XX have also confirmed that Dr. Wang's work is published in the leading international venues, which have a very high standard for accepted articles.

"*As an expert in the field, I can attest that Dr. Marinescu published in the leading journals and conferences in medical AI as well as neurology. The Medical Image Computing and Computer Assisted Surgery (MICCAI) conference, where Dr. Marinescu authored three papers, is the leading venue on theoretical and technical work on artificial intelligence and machine learning for medical applications, having an*

impact factor of 11.14. On the other hand, the neurology journal "Brain", where Dr. Marinescu authored two articles, one as joint-first author and the other as second author, is the one of the leading journals on neurology and neuroscience, which has been circulating since 1878 and has an impact factor of 11.33." (UZ, Professor of Electrical and Computer Engineering, Univ A)

"*Dr. Marinescu authored articles in the leading journals and conferences of the field. Nature Communications, where Dr. Marinescu co-authored the SuStaIn model, is a journal of outstanding research in all areas of natural sciences, with a 2-year impact factor of 12.121. Brain is one of the leading journals on neuroscience and neurology, where Dr. Marinescu published two articles, one as joint-first author. Neuroimage is another leading journal covering research in neuroimaging, with an impact factor of 5.8. Several well-known and prolific authors have published in Neuroimage, including Karl Friston and Arthur W. Toga. In terms of conferences, Dr. Marinescu has published multiple articles in the Medical Image Computing and Computer Assisted Interventions (MICCAI) and Information Processing in Medical Imaging (IPMI) conferences. These are highly technical conferences where key AI experts in medicine, as well as AI and pharmaceutical companies attend. As a clinical researcher in brain diseases, I can confirm that many of the methods published in these two conferences have a strong downstream impact on the medical problems we work on.*" (TF, Professor of Neuropsychology, XYZ)

2.2.3 Dr. Wang's scientific articles have been cited significantly more than the articles of his peers

The articles authored by Dr. Marinescu have been cited significantly more than the average of their field, as compared to the impact factor of the journals and conferences where they were published (the impact factor measures how many citations an article from that respective journal receives on average in the 2 years since its publication). Dr. Wang's articles published in the Brain journal have gathered 54 and 32 citations within the first two years, significantly higher than the average of 11.3 citations articles in the Brain journal gather in their first two years. Similarly, Dr. Wang's Nature Communications article gathered 59 citations in the first 2-years, significantly higher than the average of 12.1 citations for articles in that journal, while his NeuroImage article gathered 24 citations, significantly higher than the average of 5.9 citations for articles in that journal.

When taking all publications of Dr. Wang into account, his 485 citations gathered so far place him within the top 1% percentile of scholars in Computer Science according to the ESI ranking [Exhibit 22].

2.3 Evidence that Dr. Wang has been asked to judge the work of others in medical Artificial Intelligence and adjacent areas

Dr. Wang has been a reviewer on multiple years for the top conferences and journals in the fields of artificial intelligence, machine learning, computer vision, and medical imaging [Exhibit 15]:

- Computer Vision and Pattern Recognition (CVPR): with an impact factor of 51.9 and an h5-index of 299, it is ranked #1 by guide2research.com among Machine Learning and Artificial Intelligence conferences [Exhibit 14].

- Neural Information Processing Systems (NeurIPS): with an impact factor of 39.4 and an h5-index of 198, it is ranked #2 by guide2research.com among Machine Learning and Artificial Intelligence conferences [Exhibit 14].
- International Conference on Machine Learning (ICML): with an impact score of 18.4 and an h5-index of 171, it is ranked #6 in Artificial Intelligence and Machine Learning [Exhibit 14].
- Medical Image Computing and Computer Assisted Surgery (MICCAI): with an impact factor of 9.7 and an h5-index of 61, it is ranked #1 by guide2research.com in Biomedical and Medical Informatics.
- Information Processing in Medical Imaging (IPMI): with an impact score of 3.13, IPMI is widely recognized as a preeminent international forum for presentation of cutting edge research in the medical imaging field. [Exhibit 14]
- NeuroImage: with an impact factor of 5.88 and an h5-index of 115, NeuroImage is the most selective journal for neuroimaging analysis. [Exhibit 14]
- Nature Communications: with an impact factor of 12.1, it is a leading journal in the natural sciences. [Exhibit 14]
- Medical Image Analysis (MedIA): with an impact factor of 11.1 and an h5-index of 67, it is a leading journal in medical imaging research. [Exhibit 14]
- IEEE Transactions on Pattern Analysis and Machine Intelligence (PAMI): with an impact factor of 17.8 and an h5-index of 131, it is a leading computer vision journal [Exhibit 14].
- Journal of Alzheimer's Disease (JAD): with an impact factor of 3.9, JAD is a well-known journal focusing on etiology, pathogenesis, epidemiology, genetics, treatment, and psychology of Alzheimer's disease.

Dr. Wang has reviewed a total of 30 scientific articles [Exhibit 15]: 1 article for CVPR, 3 for NeurIPS, 6 for ICML, 6 for MICCAI, 8 for IPMI, 1 for NeuroImage, 1 for Nature Communications, 1 for MedIA, 1 for PAMI and 2 for JAD. While Dr. Wang has reviewed significantly for conferences in the field of medical Artificial Intelligence, Computer Vision and adjacent areas, this is because in these fast-moving fields, most researchers do not publish in journals. In addition, these conference publications are not just abstracts, but full scientific articles of at least 8-10 pages, with consistent supplementary material, and provide significant theoretical and experimental advances on the explored topic.

"*The journals and conferences Dr. Marinescu has published and reviewed for are the leading journals in the field. For example, the journal Brain, on which I serve as an editor, has a very high acceptance standard, and only the leading scientific articles with major impact to the field are accepted. Other journals such as Nature Communications and NeuroImage also have a similarly high standard. Similarly, the leading international conferences in medical AI, Medical Image Computing and Computer Assisted Intervention (MICCAI) and Information Processing in Medical Imaging (IPMI), also only accept truly novel contributions. In addition, in contrast to conferences that only require abstract submissions, these conferences require articles fully describing the methods and results in their entirety, so publications in*

MICCAI and IPMI are often comparable to journal publications in their own right. " (GC, Professor of Neuroradiology, University of ABC)

"*Dr. Marinescu has not only published in the leading journals and conferences of the field, but also reviewed the work of other scientists for these journals. This is a crucial service for the research community, as it helps keep the publication standard to a very high quality. I should emphasize that only leading researchers with domain knowledge and expertise are invited to review for such journals and conferences.*" (TF, Professor of Neuropsychology, XYZ)

2.4 Evidence of Dr. Wang's performance in a leading role in distinguished organizations

2.4.1 Dr. Wang was the President of the MIT Postdoctoral Association

2.4.1.1 The MIT Postdoctoral Association is a distinguished organization

The Massachusetts Institute of Technology is the world's leading institute in modern science, engineering, mathematics and technology, and ranks among the most prestigious academic institutions in the world. MIT employs approximately 11,000 research staff: 6990 graduate students, 1400 postdoctoral researchers, 1067 faculty and 1766 research staff [Exhibit 19].

The postdoctoral researchers, comprising approximately 13% of the researchers at MIT, are critical for the research environment at MIT: given their completion of the PhD and dissertation, they have ample expertise in a given topic which they pass on to the junior researchers, and further deepen or broaden their dissertation research. In addition, they often supervise graduate students and lead research projects in the laboratory.

The MIT Postdoctoral Association (PDA) is an MIT-wide organization which runs career and personal development programs for all Postdoctoral Researchers at MIT, currently numbering more than 1,400. Furthermore, it works with the MIT administration to enhance and improve all aspects of the postdoctoral research experience. Given it is the only organization that represents all postdoctoral researchers at MIT, it's role is critical for all the 1400+ postdoctoral researchers at MIT and for the entire MIT research community.

"*The MIT Postdoctoral Association (PDA) is an organization that supports MIT postdoctoral researchers during their professional research and career development. The Association oversees all postdoctoral researchers at MIT, currently numbering more than 1500, which are spread across more than 50 research centers and institutes across MIT. The association serves as a liaison between postdoctoral researchers and the faculty and administration of MIT, and strives to engage with and improve the MIT community. The MIT PDA aims to enhance all aspects of the postdoctoral research experience, and foster a sense of community which promotes and encourages an environment of peer support. The MIT PDA has an Executive Board which is responsible for the general operations, and is currently composed of five executive officers: President, Vice President, Treasurer, Corresponding Secretary and Recording Secretary. The association also comprises a standing committee of around nine additional officers, responsible for*

fulfilling specific responsibilities. The MIT PDA is governed by a constitution, which was last ratified in 2012. Given all the functions and responsibilities that the Postdoctoral Association has, its role is of critical importance for all postdoctoral researchers at MIT, and for MIT altogether." (FC, Professor at UV)

2.4.1.2 As the President of the MIT Postdoctoral Association, Dr. Wang was in the leading role

The PDA President position is highly competitive and is obtained through an electoral process where all postdoctoral researchers at MIT vote on multiple candidates based on their manifesto and prior leadership experience. Dr. Wang was elected due to his his sound manifesto outlining several key proposals that will improve the MIT postdoctoral experience, alongside prior leadership experience at Imperial College and University College London. [Exhibit 19]

"*Dr. Marinescu was initially elected in August 2019 as Vice President of the PDA by the MIT postdoctoral researchers. However, two months later, due to the previous President having to unexpectedly leave the role, Dr. Marinescu was voted by the PDA board as the new President. [...] I should emphasize that obtaining such an executive role in the Postdoctoral Association is extremely difficult, as anyone of the 1500 postdoctoral researchers at MIT can stand for election, and the candidates each need to prepare a clear manifesto outlining solutions to key problems, and convince all other postdoctoral researchers to vote them. Prior leadership experience is also essential to be elected in such a role.*" (FC, Professor at UV)

The PDA President role that Dr. Wang had comes with significant responsibilities, such as presiding and chairing the General Board Meetings of the Postdoctoral Association, representing the association in the meetings with the MIT administration, and internally, running the association and training all incoming officers.

"*In the role of PDA president, Dr. Marinescu had significant responsibilities. He presided, chaired and set the agenda for all General Meetings, acted as a liaison between the MIT PDA and the Office of the Vice President for Research, acted as a representative of MIT PDA in the Faculty Postdoc Advisory Committee. Internally, he was responsible for the overall condition of the Postdoctoral Association, ensured that all other officer positions are filled, and coordinated the training of incoming officers. The PDA President role is very demanding, as it involves organizing and running a board of 15-20 PDA officers, representing all MIT postdoctoral researchers, currently numbering more than 1500, in faculty meetings and externally outside MIT, and listening to the needs of postdoctoral researchers and working with the PDA board to find solutions.*" (FC, Professor at UV)

2.4.1.3 Dr. Wang's leadership in the MIT Postdoctoral Association had substantial impact for all postdoctoral researchers at MIT

Dr. Wang led the MIT Postdoctoral Association to launch several initiatives, such as career development programs, academic and industry panels, a new Diversity, Equity and Inclusion journal club. In addition, Dr. Wang initiated a session for postdoctoral researchers to meet representatives of the MIT Corporation as well as Prof. Maria Zuber, the MIT Vice President for Research.

"*Under the leadership of Dr. Marinescu, the MIT Postdoctoral Association has had many accomplishments and launched many initiatives for all postdoctoral researchers at MIT. It ran several career development programs, such as a six-month mentorship program for both academia as well as industry, several panel discussions on topics regarding academic research and future career pathways, and also launched a new Diversity, Equity and Inclusion journal club, where MIT postdoctoral researchers discussed scientific articles on diversity and inclusion topics. They also started collaborations with other Postdoctoral Associations, such as the Boston-Area PDA, as well as the Harvard PDA. Perhaps one of the most important initiatives undertaken by Dr. Marinescu was to organize a session where 10 representative postdoctoral researchers across MIT met with 15 members of the MIT Corporation who were visiting the office of the Vice President for Research, in order to give them feedback about postdoctoral academic life. The session had a major impact for all postdoctoral researchers at MIT, as it provided the required impetus to address multiple problems, in particular regarding housing affordability and general living expenses.*" (FC, Professor at UV)

Dr. Wang also led advocacy efforts in new directions, such as for better housing and child support for postdoctoral researchers with families:

"*Dr. Marinescu, as PDA President, has also led new directions of advocacy for the PDA. During his tenure, the PDA has started advocating on key issues facing postdoctoral researchers at MIT: the ability to find affordable housing, increased childcare support for researchers with children, improved career development programs, and more opportunities for interaction and collaboration between postdoctoral researchers across different institutes at MIT. These directions have been identified after discussing with a broad range of postdoctoral researchers across MIT, in order to understand their needs.*" (FC, Professor at UV)

As PDA President, Dr. Wang was on the hiring committee for the MIT Institute Community and Equity Officer (ICEO), which selected John Dozier in February 2020 [Exhibit 16].

"*During his tenure, Dr. Marinescu, as PDA President, was also on the hiring committee for the new MIT Institute Community and Equity Officer (ICEO), which selected in February 2020 John Dozier, an experienced higher-education leader, in the role. Given that I have myself been the MIT ICEO during 2013–2018, I can confirm that the ICEO is a critical role at MIT, and reports straight to the [MIT] Provost, Martin A. Schmidt, with a mandate to develop and implement diversity and inclusion strategies for the [MIT] institute.*" (FC, Professor at UV)

2.4.2 Dr. Wang organised and ran TADPOLE, the largest international competition of AI algorithms for predicting Alzheimer's disease

2.4.2.1 TADPOLE is a distinguished, one-of-a-kind competition and benchmark

The Alzheimer's Disease Progression of Longitudinal Evolution (TADPOLE) Challenge, organized by Dr. Marinescu, is the largest international competition to date for researchers to build AI algorithms for predicting Alzheimer's disease. TADPOLE is a collaboration of two consortia: the EuroPOND consortium (www.europond.eu) and the Alzheimer's Disease Neuroimaging Initiative (ADNI) consortium

(http://adni.loni.usc.edu). Thirty-three international teams participated in the competition, and submitted a total of 92 different AI algorithms. The challenge brought together sponsorship of £30,000, to be offered as prizes to participants, from the three main Alzheimer's disease charities worldwide: Alzheimer's Association, Alzheimer's Society, and Alzheimer's Research UK.

"*I have first come in contact with his [Dr. Marinescu's] work in 2017, when my research team decided to participate in TADPOLE, the international challenge Dr. Marinescu organized which aimed to evaluate algorithms that predict the progression of Alzheimer's disease. TADPOLE is a one-of-a-kind challenge and benchmark for comparing a variety of algorithms and methods for the challenging task of predicting Alzheimer's disease, a key neurodegenerative disease affecting millions of people worldwide. While previous algorithms in our research field were all tested on different datasets and with different target variables to be predicted, TADPOLE created a standardized evaluation framework which made all algorithms' performance comparable. Thirty-three international teams from nine different countries, with approximately three members each, participated in the challenge, and submitted a total of ninety-two prediction algorithms.*" (UZ, Professor of Electrical and Computer Engineering, Univ A)

2.4.2.2 Dr. Wang has played a leading role in the organisation of TADPOLE

Dr. Wang played a leading role in the organization of TADPOLE. He created the main datasets for all thirty-three participating teams to use, helped the teams in running their algorithms on the data, created benchmark algorithms for teams to build on, evaluated the teams' predictions on newly acquired data, and presented the final results at the Medical Image Computing and Computer Assisted Surgery, the main conference in the field. While other members of the consortium have also been involved in other aspects of the competition, Dr. Wang has been the key person to run the challenge and analyse all final results, and work with all members of the consortia and teams to put together three articles detailing the design and all results of the challenge [Exhibit 11]. As evidence for this, he was the first-author of these influential articles [Exhibit 11], which have already gathered more than 88 citations.

"*Dr. Marinescu has also been the key leader in the organization and running of the TADPOLE Challenge, and played a critical role at various points along the process. He was among the four main organizers (alongside Daniel Alexander, Neil Oxtoby and Alexandra Young) who initially came up with the design of the challenge and created the website detailing the competition, co-created with Neil Oxtoby the datasets for the teams, assisted the teams with running their algorithms and with the tasks they had to solve, solely evaluated and analyzed all the prediction results, and liaised with all the participating teams on accurately synthesizing the description of their algorithms in the final manuscript. Dr. Marinescu presented these results in three scientific articles that already have more than 60 citations. He also presented the final results at the Medical Image Computing and Computer Assisted Surgery (MICCAI) International Conference, the leading venue in medical AI, as well as at the Alzheimer's Association International Conference, the top conference on Alzheimer's disease research.*" (UZ, Professor of Electrical and Computer Engineering, Univ A)

"*Dr. Marinescu has been an outstanding leader during the organization and running of TADPOLE. He helped all the teams, including ourselves, understand the problem statement, how to use the dataset, and*

even offered us algorithms to get started with. When we had clarifications, we always reached out to him on the forum. He also analysed all our submissions and worked with us to summarize all our technical methods in the final manuscript. He also presented the final analysis at two key conferences, the Medical Image Computing and Computer Assisted Interventions (MICCAI 2019), as well as the Alzheimer's Association International Conference (AAIC 2020). " (DI, Senior Director of XYZ, Company ABC, USA)

2.4.2.3 TADPOLE had a substantial impact on Alzheimer's disease research

Under Dr. Wang's leadership, the impact of TADPOLE on Alzheimer's disease research has been highly significant. TADPOLE helped establish what are the best AI prediction models for Alzheimer's disease, and what are the capabilities of state-of-the-art AI models on Alzheimer's prediction. For this, TADPOLE gathered together the best teams worldwide from both academia and industry to implement the state-of-the-art AI models, and established a standard of measuring their performance. When adopted into clinical settings, such models will impact millions of patients with Alzheimer's disease worldwide.

"*Through TADPOLE, Dr. Marinescu made a huge scientific contribution to our research field. First, it helped establish how well and how early we can predict Alzheimer's disease with computational algorithms, what are the state-of-the-art algorithms for Alzheimer's disease prediction, and what types of input data are most informative for such predictions. Secondly, Alzheimer's disease is a devastating disease worldwide, with currently more than 50 million people affected, and having associated costs of approximately $100 billion in the United States alone. The ability to detect the disease early, using such AI algorithms, can improve the healthcare management of millions of people worldwide, and also lower the economic costs and caregiver efforts for managing Alzheimer's disease patients.*" (UZ, Professor of Electrical and Computer Engineering, Univ A)

"*The impact of the TADPOLE competition in Alzheimer's disease prediction research cannot be overstated: around 30-40 international teams participated in the competition from both academia and the biotech. industry, and it entirely reshaped the field regarding what are the best AI methods for predicting such a disease.*" (DI, Senior Director of XYZ, Company ABC, USA)

TADPOLE had a major impact not just within academia, but also in the pharmaceutical industry. XX, a major biopharmaceutical company, participated in the challenge, while XYZ, another major biopharmaceutical company, has closely followed the work.

"*I have first heard of Dr. Marinescu's work in 2017, when our team at XX decided to participate in the TADPOLE Challenge, which he organised during his PhD at University College London. As part of the challenge, we had to create an [AI] algorithm that could automatically predict which subjects would develop Alzheimer's disease in the future. This task was well aligned with our objectives of building computational AI models for early diagnosis of diseases such as Alzheimer's disease. While we had many years of experience with such algorithms, it was not an easy task due to the unfamiliarity with the data. Eventually, we managed to create a good algorithm for making accurate predictions, and we ended up winning the grand prize of the competition, worth £10,000.*" (DI, Senior Director of XYZ, Company ABC, USA)

"*Another influential work by Dr. Marinescu that we have been paying very close attention is the*

TADPOLE Competition, which compares algorithms at predicting the progression of individuals at risk of Alzheimer's disease. These algorithms are highly useful towards identifying the most suitable patients that can go into our clinical trials, i.e. those that will benefit the most from the drug treatments. This solves one key issue we often face in clinical trials, that of cohort diversity due to different underlying genetics and pathology, which often obscures treatment effects. The computational models from the TADPOLE Challenge can help us select homogeneous groups of patients, thereby increasing the treatment effects in drug trials." (TI, Vice President of M, Company XYZ, USA)

Finally, as mentioned earlier in section 2.1.2, TADPOLE has also been featured in popular media, in an article written by Alzforum [Exhibit 11].

3 The final merits of Dr. Wang's extraordinary ability

In accordance with the Kazarian opinion, the second step of the two-part approach is a final merits determination that considers all of the evidence in the context of whether or not the petitioner has demonstrated:

- A level of expertise indicating that Dr. Wang is "one of that small percentage who have risen to the very top of the field of endeavor." 8 C.F.R. §204.5(h)(2) – section 3.1.
- Dr. Wang's sustained national or international acclaim and that his achievements have been recognized in the field of his expertise. 8 C.F.R. §204.5(h)(3) – section 3.2.

3.1 Dr. Wang has risen to the very top of the field of medical Artificial Intelligence

Dr Marinescu is a scientist of extraordinary ability, who is recognized to have risen to the very top of the field of medical AI. His work on AI prediction models for neurodegenerative diseases has impacted not just academia, but also the pharmaceutical industry.

"*Given his major contributions in the field of medical Artificial Intelligence, in particular through his scientific publications, Dr. Marinescu is truly among the very top of his research field. His work has had significant impact not just in academia, but also in the biopharmaceutical industry, best exemplified by the fact that our company XX put together a team to participate in his challenge and build an AI prediction model for Alzheimer's disease. Moreover, his research work has impacted not just Alzheimer's disease, but many other diseases such as Multiple Sclerosis and Frontotemporal dementia, which are major healthcare challenges of our times and into the future.*" (DI, Senior Director of XYZ, Company ABC, USA)

"*Dr. Marinescu is a leading scientist who has risen to the very top of the field of medical Artificial Intelligence. His AI models are already used by our research team at XX, and we are currently keeping a close collaboration with him. In addition, Dr. Marinescu has extraordinary technical skills, as well as a deep fundamental understanding of medical problems. As the VP for Personalized Medicine at XX, who has been involved with recruiting top talent for many years, I can assure you that Dr. Marinescu's skills and contributions are only matched by a very small percentage of researchers worldwide.* " (TI, Vice President of M, Company XYZ, USA)

"*Dr. Marinescu is scientist of extraordinary ability, who has made many contributions to our research field. He is a highly recognized leader in disease progression modeling and artificial intelligence prediction algorithms for medicine, two very important scientific areas. If he is to stay in the United States, he would be a great asset to the country, and can continue to make important new contributions in research and beyond.*" (UZ, Professor of Electrical and Computer Engineering, Univ A)

"*Dr. Marinescu has made outstanding contributions of great impact to field of Artificial Intelligence and Machine Learning in Medicine. He is truly among the very top researchers in his field. Following his PhD at University College London, he was invited to pursue his research further at the Massachusetts Institute of Technology in the Computer Science and Artificial Intelligence Laboratory, the world's best research laboratory for his field. I was very fortunate to have worked with him during his PhD, and I am certain his career trajectory will further increase.*" (TF, Professor of Neuropsychology, XYZ)

In addition, Dr. Wang's scientific articles have been cited more than 485 times [Exhibit 2], which places him within the top 1% of researchers in computer science, according to the ESI index [Exhibit 22]. This is additionally confirmed by the Google Scholar ranking [Exhibit 2], where the top-5 publications in the top-100 journals generally have 100-300 citations over the last 5 years (as measured by the h5-index), which results in around 20-60 citations/year [Exhibit 21]. Three of Dr. Wang's articles have more than 20 citations within last year [Exhibit 2].

3.2 Dr. Wang has sustained national and international acclaim in his field of expertise

Dr. Wang has not only had contributions of international acclaim, but has also sustained them. Over the last 6 months, Dr. Wang's articles have already been cited 154 times [Exhibit 2], showing an exponential increase in the impact of his work. In addition, several research groups have already expressed interest in his very recent work on image reconstruction.

"*Dr. Marinescu's work is well recognized in the scientific community. He is well-known for his outstanding work on disease progression models, having authored more than six papers on this topic, and his organization of TADPOLE, currently the most widely-used benchmark for comparing models at predicting the progression of Alzheimer's disease. In addition, his work on image reconstruction using generative priors has already raised the interest of several research groups, including that of Alexander Goehler, a clinical scientist at Harvard Medical School, who would like to apply it for studying liver disease, as well as Steven Horng's group at Beth Israel, who recently invited Dr. Marinescu to give a talk at the Harvard Clinical Informatics Lecture Series.*" (QR, Professor of EECS, MIT)

Over the past 12 months, Dr. Wang has been invited to give four talks at leading universities worldwide such as Harvard University, Stanford University, University of British Columbia and University of California Santa Cruz [Exhibit 1]. In addition, Dr. Wang recently interviewed for tenure-track academic positions in the United States, further confirming his sustained performance.

"*Dr. Marinescu has already interviewed for tenure-track faculty positions at leading universities in the United States, and is now waiting for the final decisions. While there are usually more than one hundred applicants for these positions, all PhD graduates of very good caliber, only the top 5 are generally invited*

to interview. This makes Dr. Marinescu one of the very top researchers in the field of medical AI." (QR, Professor of EECS, MIT)

Dr. Wang was recently asked in January 2020 to give an interview to *Adevarul* (eng. *Truth*), one of the leading newspapers in Romania, to discuss about his research and how Artificial Intelligence will impact future healthcare [Exhibit 18]. *Adevarul* is one of the most popular and trusted press venues of Romania, founded in 1871. This confirms the ongoing recognition Dr. Marinescu receives not just in academia, but also in popular media.

4 Conclusion

Dr. Wang is a well-recognized expert in Medical Artificial Intelligence who has risen to the very top of his field of endeavor. He is going to continue working in the field of his expertise in the United States. Supporting letters from experts in the field state that Dr. Wang's discoveries and contributions would be beneficial to the United States in the medical and healthcare sectors, and will benefit millions of people with neurodegenerative diseases.
Thus, Dr. Wang fully satisfies all requirements and regulations listed in INA Section 203(b)(1)(A) and 8 CFR Section 204.5(h) and the reviewer is kindly asked to approve Dr. Wang's petition for permanent residence under the category of an alien of extraordinary ability.

Please contact me at the following address for any additional evidence.

Yours faithfully,

Razvan V. Marinescu

Address: XX
Tel: XXXXX
Email: XX
Website: http://razvan.csail.mit.edu

Statement from Dr. Wang detailing plans on how he intends to continue work in the United States

5 February 2025

My name is Razvan Marinescu. I am the beneficiary of this I-140 Immigrant Petition for Alien Worker, seeking EB-1A classification as an individual of extraordinary ability. I have a vast experience in the field of Artificial Intelligence for Medicine, and I intend to continue doing research in this area in the United States.

After finishing my postdoctoral research at the Massachusetts Institute of Technology (MIT), I plan to start a tenure-track academic position in the United States. I have already interviewed at several US universities, and I'm expecting to be given offers at any point. I really enjoy teaching and research, so the position of an assistant professor in academia best suits my interests and expertise. At the same time, I will continue ongoing medical AI projects we currently have with several companies, including IBM, Boston Scientific, Takeda Pharmaceuticals and Biogen.

Getting the permanent residence in the United States will increase my research opportunities. For example, many research grants at the National Science Foundation (NSF) or the National Institutes of Health (NIH) are restricted to only US citizens and permanent residents. With the permanent residency, I will be able not only to apply for such grants, but also attract and fund the most talented students to solve challenging world problems.

My area of expertise, medical Artificial Intelligence, will vastly influence future healthcare, as the technology that will be introduced in hospitals will improve the lives of millions of patients not only within the United States, but also worldwide. The unique healthcare ecosystem of the United States offers incredible opportunities to do my research work. In return, I will train the next generation of scientists in medical Artificial Intelligence. My work in the United States can immensely benefit not only the healthcare system and peoples' well-being, but also the national economy, as my AI technologies can make healthcare cheaper and more accessible, particularly in under-developed regions.

I will be very grateful if I am given the chance to benefit the US science and economy given my expertise in medical Artificial Intelligence.

Yours faithfully,

Razvan V. Marinescu

Address: XX
Tel: XXXXX
Email: XX
Website: http://razvan.csail.mit.edu

List of Exhibits

Academic and professional Background

Exhibit 1: Curriculum Vitae of Dr. Yu Wang

Exhibit 2: Google Scholar Profile of Dr. Yu Wang

Supporting Letters

Exhibit 3: Supporting letter and bio from Prof QR

Exhibit 4: Supporting letter and bio from Prof UZ

Exhibit 5: Supporting letter and bio from Prof GC

Exhibit 6: Supporting letter and bio from Prof TF

Exhibit 7: Supporting letter and bio from Prof TI

Exhibit 8: Supporting letter and bio from Prof DI

Exhibit 9: Supporting letter and bio from Prof FC

Key scientific publications authored by Dr. Marinescu

Exhibit 10: First pages of 2 publications authored by Dr. Marinescu on Posterior Cortical Atrophy:

- Firth, Nicholas C., Primativo, Silvia, Marinescu, Razvan V., et al. "Longitudinal neuroanatomical and cognitive progression of posterior cortical atrophy." Brain 142.7 (2019): 2082-2095.
- Marinescu, Razvan V., "Modelling the Neuroanatomical Progression of Alzheimer's Disease and Posterior Cortical Atrophy." University College London, (2020) - PhD thesis

Exhibit 11: First pages of 3 publications authored by Dr. Marinescu on the TADPOLE Challenge, alongside a media article from Alzforum on the results of the Challenge

- Marinescu, Razvan V., et al. "Tadpole Challenge: Prediction of longitudinal evolution in Alzheimer's disease." arXiv preprint arXiv:1805.03909 (2018), under review.
- Marinescu, Razvan V., et al. "The Alzheimer's Disease Prediction Of Longitudinal Evolution (TADPOLE) Challenge: Results after 1 Year Follow-up." arXiv preprint arXiv:2002.03419 (2020).
- Marinescu, Razvan V., et al. "TADPOLE Challenge: Accurate Alzheimer's disease prediction through crowdsourced forecasting of future data.", International Workshop on PRedictive Intelligence In MEdicine Springer, MICCAI, Cham, 2019.

- Media article from Alzforum about the results and findings of the TADPOLE Challenge: https://www.alzforum.org/news/community-news/tadpole-challenge-winners-forecast-ad-symptoms
- Wikipedia article about Alzforum, an independent, non-profit website and community for accelerating research in Alzheimer's disease.

Exhibit 12: First pages of 2 publications authored by Dr. Marinescu on the DIVE model, that estimates the progression of Alzheimer's disease:

- Marinescu, Razvan V., et al. "DIVE: A spatiotemporal progression model of brain pathology in neurodegenerative disorders." NeuroImage 192 (2019): 166-177.
- Marinescu, Razvan V, et al. "A vertex clustering model for disease progression: application to cortical thickness images." International conference on information processing in medical imaging. Springer, Cham, 2017.

Exhibit 13: First pages of 2 publications authored by Dr. Marinescu on disease progression modelling of Multiple Sclerosis and Frontotemporal dementia:

- Eshaghi, Arman, Marinescu, Razvan V., et al. "Progression of regional grey matter atrophy in multiple sclerosis." Brain 141.6 (2018): 1665-1677.
- Young, Alexandra L., Marinescu, Razvan V., et al. "Uncovering the heterogeneity and temporal complexity of neurodegenerative diseases with Subtype and Stage Inference." Nature communications 9.1 (2018): 1-16.

Other

Exhibit 14: Journal and conference rankings by category

Exhibit 15: Proof of 30 scientific reviews undertaken by Dr. Marinescu in conferences and journals on artificial intelligence, computer vision and medical imaging.

Exhibit 16: Proof that Dr. Marinescu was on the hiring committee of the MIT Institute Community and Equity Officer (ICEO)

Exhibit 17: Nadri, Hamed, et al. "The top 100 articles in the medical informatics: a bibliometric analysis." Journal of medical systems 41.10 (2017): 1-12.

Exhibit 18: Media article on Dr. Marinescu's research in *Adevarul*, one of the most popular and trusted newspapers in Romania. Certified translation in English also attached.

Exhibit 19: Evidence towards Dr. Wang's leadership role as President of the MIT Postdoctoral Association

1. Statistics about the faculty and research staff at MIT.
2. Newsletter about the MIT postdoc population, and their importance towards groundbreaking research done at MIT.

3. Welcome Letter from Prof. Maria Zuber, MIT VP for Research, on Dr. Wang's initial election as Vice-President of the MIT PDA.
4. Email from XX, MIT PDA advisor, confirming Dr. Wang stepping up to the President role of MIT PDA.
5. Screenshot from MIT PDA website, confirming Dr. Wang as President during 2019-2020 (https://pda.mit.edu/about/previous-pda-officers/).
6. Diploma of appreciation from the MIT VP for Research.
7. Achievements of the MIT PDA, as listed on the MIT PDA website (https://pda.mit.edu/advocacy/achievements/).

Exhibit 20: Evidence towards Dr. Wang's leadership role as the organizer of the TADPOLE Challenge

1. Email from Dr. Wang towards all TADPOLE participants and advisors, regarding the announcement of the competition's final results.
2. Email from Dr. Wang towards all TADPOLE participants and advisors, announcing the submission of the manuscript towards a journal publication.
3. Email from Dr. Wang towards the organisation of a Featured Research Session on TADPOLE Challenge at the Alzheimer's Association International Conference.
4. Screenshot from the oral presentation given by Dr. Wang on the final results of TADPOLE Challenge, at the Alzheimer's Association International Conference. (https://www.youtube.com/watch?v=wYHS9OW-Dv8)
5. First pages of three articles authored by Dr. Wang on the TADPOLE Challenge, confirming his leadership role through first-authorship.

Exhibit 21: Number of citations of top-5 articles in top 100 publications worldwide

Exhibit 22: Number of citations of top 1% authors percentile according to the ESI index.

Exhibit 23: Confirmation of PhD degree and Diploma of Dr. Wang issued by University College London, alongside confirmation of MEng degree and transcript of Dr. Wang issued by Imperial College London

Exhibit 24: Offer letter of Dr. Wang in the Computer Science and Artificial Intelligence Laboratory at the Massachusetts Institute of Technology

Exhibit 25: First pages of 6 additional publications authored by Dr. Marinescu

1. **Marinescu, Razvan V.**, et al. "Disease knowledge transfer across neurodegenerative diseases." International Conference on Medical Image Computing and Computer-Assisted Intervention. Springer, Cham, 2019.
2. **Marinescu, Razvan V.**, et al. "BrainPainter: A software for the visualisation of brain structures, biomarkers and associated pathological processes." Multimodal brain image analysis and mathematical foundations of computational anatomy. Springer, Cham, 2019. 112-120.

3. Young, Alexandra L., Oxtoby, Neil P., Huang, J., **Marinescu, Razvan V.**, et al, "Multiple orderings of events in disease progression". In International Conference on Information Processing in Medical Imaging (pp. 711-722). Springer, Cham, 2015
4. Wijeratne, P. A., Young, A. L., Oxtoby, N. P., **Marinescu, Razvan V.** et al, "An image-based model of brain volume biomarker changes in Huntington's disease". Annals of clinical and translational neurology, 5(5), 570-582, 2018
5. Slator, Paddy J., Hutter, Jana, **Marinescu, Razvan V.**, et al. "InSpect: INtegrated SPECTral component estimation and mapping for multi-contrast microstructural MRI." International Conference on Information Processing in Medical Imaging. Springer, Cham, 2019.
6. Garbarino, Sara, Marco Lorenzi, Neil P. Oxtoby, Elisabeth J. Vinke, **Marinescu, Razvan V.** et al., "Differences in topological progression profile among neurodegenerative diseases from imaging data." Elife 8 (2019): e49298.

Exhibit 1

Curriculum Vitae of Dr. Yu Wang

Razvan Valentin Marinescu

Website: http://razvan.csail.mit.edu
Github: https://github.com/razvanmarinescu
Twitter: https://twitter.com/RazMarinescu
Address: MIT CSAIL, 32 Vassar St., Office D475B
Email: razvan [at] csail.mit.edu

Research Interests

- Machine learning for medicine, particularly for neuroscience applications
- Generative modeling using deep learning architectures, for image reconstruction and manipulation
- Bayesian modelling, statistical inference, efficient sampling
- Time-series models with latent variables, for capturing disease processes
- Causal machine learning, for building robust models able to deal with distribution shifts

Education

2019 - now | **Postdoctoral Associate, CSAIL, Massachusetts Institute of Technology**
Advisor: Polina Golland
Research focus: generative models, image reconstruction, Bayesian inversion

2014 - 2019 | **PhD, Center for Medical Image Computing, University College London**
PhD thesis: "Modelling the Neuroanatomical Progression of Alzheimers Disease and Posterior Cortical Atrophy" – Supervisors: Prof. Daniel Alexander, Prof. Sebastian Crutch, Dr. Neil Oxtoby
Research focus: bayesian latent-variable models, machine learning, neuroimaging, disease progression modelling.

2010 - 2014 | **MEng, Department of Computer Science, Imperial College London**
First Class Honours (top 10% of class in final year)
Master thesis: "On a new metric to compare internal structures in biological networks"
Supervisor: Prof. Natasa Przulj

Past Employment

2016 - 2018 | **Teaching Assistant in Computational Modelling, UCL**
Taught computational modelling, bayesian statistics and numerical optimisation to Master students. Marked the students' coursework.

2014 - 2018 | **Graduate Residence Advisor, University College London**
Provided pastoral support to students and emergency support.

2012 - 2013 | **Teaching Assistant in Programming, Imperial College London**
Taught Haskell, Java and C to undergraduate students. Weekly marking of students' coursework.

2013 | **Industrial Placement at J.P. Morgan Chase & Co, Emerging Markets**
Assisted the retirement of a legacy system that was processing end-of-day market risk.

2012 | **Summer Internship at Goldman Sachs, Equities Technology**
Built software that automatically re-factored the Java source-code of a trading system. Learned about financial instruments and live market data.

Awards

2017	Runner up (jointly) for the Francois Erbsmann Prize (best paper award) at the IPMI conference.
2015-17	Travel and registration fellowships for several conferences: IPMI, AAIC and Human Brain Project.
2013	DAAD Scholarship for doing a German Language course in Aachen, Germany over the summer.
2011	Prize for the best undergraduate project in Artificial Intelligence, Imperial College London
2010	Sponsored visit to NATO Headquarters, Brussels, for achievements in international projects and contests.
2009	Grand Prize at the International Space Settlement Design Competition offered by NASA Johnson Space Center.
2008	Diploma of Excellency awarded by the Government of Romania for "impressive problem-solving skills".
2007	Bronze Medal at the 6th International Computer Project Competition "Infomatrix".
	Silver Medal at the *National Mathematics Olympiad* in Romania.

Other significant activities

2019-20	President of the MIT Postdoctoral Association
2016-17	Taught Robotics and Computer Graphics courses at the Oxford for Romania Summer School
2011-14	Year representative at Imperial College faculty meetings

Selected publications

2020

Conference **Marinescu, R.V.**, Moyer, D., Golland, P., 2020. Bayesian Image Reconstruction using Deep Generative Models. arXiv preprint arXiv:2012.04567.

Journal **Marinescu, R.V.**, Oxtoby, N.P., Young, A.L., Bron, E.E., Toga, A.W., Weiner, M.W., Barkhof, F., Fox, N.C., Eshaghi, A., Toni, T. and Salaterski, M., 2020. The Alzheimer's Disease Prediction Of Longitudinal Evolution (TADPOLE) Challenge: Results after 1 Year Follow-up. arXiv preprint arXiv:2002.03419., under review for Nature Communications

2019

Poster **Marinescu, R.V.**, Lorenzi, M., Blumberg, S., Young, A.L., Morell, P.P., Oxtoby, N.P., Eshaghi, A., Yong, K.X., Crutch, S.J. and Alexander, D.C., 2019. Disease Knowledge Transfer across Neurodegenerative Diseases. MICCAI, 2019.

Journal **Marinescu, R.V.**, Eshaghi, A., Lorenzi, M., Young, A.L., Oxtoby, N.P., Garbarino, S., Crutch, S.J., Alexander, D.C. and Alzheimer's Disease Neuroimaging Initiative, 2019. DIVE: A spatiotemporal progression model of brain pathology in neurodegenerative disorders. NeuroImage, 192, pp.166-177.

Journal (*joint first-authors) *Firth, N.C., *Primativo, S., ***Marinescu, R.V.**, Shakespeare, T.J., Suarez-Gonzalez, A., Lehmann, M., Carton, A., Ocal, D., Pavisic, I., Paterson, R.W. and Slattery, C.F., 2019. Longitudinal neuroanatomical and cognitive progression of posterior cortical atrophy. Brain.

2017

Oral **Marinescu, R.V.**, Eshaghi, A., Lorenzi, M., Young, A.L., Oxtoby, N.P., Garbarino, S., Shakespeare, T.J., Crutch, S.J., Alexander, D.C. and Alzheimers Disease Neuroimaging Initiative, 2017, June. A vertex clustering model for disease progression: application to cortical thickness images. In International Conference on Information Processing in Medical Imaging (pp. 134-145). Springer, Cham. (Erbstman Prize Runner-up)

Other First author publications

2020

Oral **Marinescu, R.V.**, Bron, E.E., Oxtoby, N.P., Young, A.L., Toga, A.W., Weiner, M.W., Barkhof, F., Fox, N.C., Golland, P., Klein, S. and Alexander, D.C., 2020, July. Predicting Alzheimer's disease progression: Results from the TADPOLE Challenge. In 2020 Alzheimer's Association International Conference.

2019

Oral **Marinescu, R.V.**, Alexander, D.C. and Golland, P., 2019. BrainPainter: A software for the visualisation of brain structures, biomarkers and associated pathological processes, MICCAI MBIA Workshop, 2019

Oral **Marinescu, R.V.**, Oxtoby, N.P., Young, A.L., Bron, E.E., Toga, A.W., Weiner, M.W., Barkhof, F., Fox, N.C., Golland, P., Klein, S. and Alexander, D.C., 2019, October. TADPOLE challenge: Accurate Alzheimer's disease prediction through crowdsourced forecasting of future data. In MICCAI Workshop on PRedictive Intelligence In MEdicine.

2018

Journal **Marinescu, R.V.**, Oxtoby, N.P., Young, A.L., Bron, E.E., Toga, A.W., Weiner, M.W., Barkhof, F., Fox, N.C., Klein, S. and Alexander, D.C., 2018. TADPOLE Challenge: Prediction of Longitudinal Evolution in Alzheimer's Disease. arXiv preprint arXiv:1805.03909.

2017

Poster **Marinescu, R.V.**, Primativo, S., Young, A.L., Oxtoby, N.P., Firth, N.C., Eshaghi, A., Garbarino, S., Cardoso, J.M., Yong, K., Fox, N.C. and Lehmann, M., 2017. Analysis Of The Heterogeneity Of Posterior Cortical Atrophy: Data-driven Model Predicts Distinct Atrophy Patterns For Three Different Cognitive Subgroups. Alzheimer's & Dementia: The Journal of the Alzheimer's Association, 13(7), pp.P106-P108.

2016

Poster **Marinescu, R.V.**, Young, A.L., Oxtoby, N.P., Firth, N.C., Lorenzi, M., Eshaghi, A., Wottschel, V., Cardoso, M.J., Modat, M., Yong, K. and Primativo, S., 2016. A Data-driven Comparison Of The Progression Of Brain Atrophy In Posterior Cortical Atrophy And Alzheimer's Disease. Alzheimer's & Dementia: The Journal of the Alzheimer's Association, 12(7), pp.P401-P402.

Joint publications

2019

Journal Eshaghi, A., **Marinescu, R.V.**, Young, A.L., Firth, N.C., Prados, F., Jorge Cardoso, M., Tur, C., De Angelis, F., Cawley, N., Brownlee, W.J. and De Stefano, N., 2018. Progression of regional grey matter atrophy in multiple sclerosis. Brain, 141(6), pp.1665-1677.

Poster Slator, P.J., Hutter, J., **Marinescu, R.V.**, Palombo, M., Young, A.L., Jackson, L.H., Ho, A., Chappell, L.C., Rutherford, M., Hajnal, J.V. and Alexander, D.C., 2019, June. InSpect: INtegrated SPECTral Component Estimation and Mapping for Multi-contrast Microstructural MRI. In International Conference on Information Processing in Medical Imaging (pp. 755-766). Springer, Cham.

Journal Garbarino, S., Lorenzi, M., Oxtoby, N.P., Vinke, E.J., **Marinescu, R.V.**, Eshaghi, A., Ikram, M.A., Niessen, W.J., Ciccarelli, O., Barkhof, F. and Schott, J.M., 2019. Differences in topological progression profile among neurodegenerative diseases from imaging data, eLife

2018

Journal Young, A.L., **Marinescu, R.V.**, Oxtoby, N.P., Bocchetta, M., Yong, K., Firth, N.C., Cash, D.M., Thomas, D.L., Dick, K.M., Cardoso, J. and van Swieten, J., 2018. Uncovering the heterogeneity and temporal complexity of neurodegenerative diseases with Subtype and Stage Inference. Nature communications, 9(1), p.4273.

Journal Wijeratne, P.A., Young, A.L., Oxtoby, N.P., **Marinescu, R.V.**, Firth, N.C., Johnson, E.B., Mohan, A., Sampaio, C., Scahill, R.I., Tabrizi, S.J. and Alexander, D.C., 2018. An imagebased model of brain volume biomarker changes in Huntington's disease. Annals of clinical and translational neurology, 5(5), pp.570-582.

Poster Young, A.L., Scelsi, M.A., **Marinescu, R.V.**, Schott, J.M., Ourselin, S., Alexander, D.C. and Altmann, A., 2018. Genomewide Association Study Of Data-driven Alzheimer's Disease Subtypes. Alzheimer's & Dementia: The Journal of the Alzheimer's Association, 14(7), pp.P1042-P1043.

Poster Garbarino, S., Lorenzi, M., Vinke, E., **Marinescu, R.V.**, Oxtoby, N.P., Eshaghi, A., Ikram, M.A., Niessen, W.J., Ciccarelli, O., Barkhof, F. and Vernooij, M.W., 2018. Mechanistic Profiles Of Neurodegeneration: A Study In Alzheimers Disease, Healthy Ageing And Primary Progressive Multiple Sclerosis. Alzheimer's & Dementia: The Journal of the Alzheimer's Association, 14(7), pp.P1280-P1281.

2017

Poster Young, A.L., **Marinescu, R.V.**, Yong, K., Firth, N.C., Oxtoby, N.P., Cash, D.M., Fox, N.C., Crutch, S.J., Rohrer, J.D., Schott, J.M. and Alexander, D.C., 2017. Characterising The Progression Of Alzheimers Disease Subtypes Using Subtype And Stage Inference (Sustain). Alzheimer's & Dementia: The Journal of the Alzheimer's Association, 13(7), pp.P791-P792.

Poster Young, A.L., **Marinescu, R.V.**, Oxtoby, N.P., Bocchetta, M., Cash, D.M., Thomas, D.L., Dick, K.M., Cardoso, M.J., Ourselin, S., van Swieten, J.C. and Borroni, B., 2017. Multiple Distinct Atrophy Patterns Found In Genetic Frontotemporal Dementia Using Subtype And Stage Inference (Sustain). Alzheimer's & Dementia: The Journal of the Alzheimer's Association, 13(7), pp.P453-P454.

Poster Primativo, S., **Marinescu, R.V.**, Firth, N.C., Yong, K., Shakespeare, T.J., Gonzalez, A.S., Carton, A.M., Lehmann, M., Slattery, C.F., Paterson, R.W. and Foulkes, A.J., 2017. Longitudinal Evaluation Of Neuropsychological And Neuroimaging Progression In Posterior Cortical Atrophy. Alzheimer's & Dementia: The Journal of the Alzheimer's Association, 13(7), pp.P1382-P1383.

Poster Oxtoby, N.P., Young, A.L., **Marinescu, R.V.** and Alexander, D.C., 2017. Data-driven Models Of Disease Progression And Applications To Alzheimers Disease: Event-based Model And Differential Equation Models Of Biomarker Changes In ADNI. Alzheimer's & Dementia: The Journal of the Alzheimer's Association, 13(7), pp.P1323-P1325.

2016

Poster Firth, N.C., Brotherhood, E., Primativo, S., Young, A.L., **Marinescu, R.V.**, Oxtoby, N.P., Crutch, S.J. and Alexander, D.C., 2016. Data-driven Disease Progression Modelling Using Neuropsychological Tests: Posterior Cortical Atrophy Vs Alzheimer's Disease. Alzheimer's & Dementia: The Journal of the Alzheimer's Association, 12(7), pp.P963-P964.

2015

Poster Young, A.L., Oxtoby, N.P., Huang, J., **Marinescu, R.V.**, Daga, P., Cash, D.M., Fox, N.C., Ourselin, S., Schott, J.M., Alexander, D.C. and Alzheimer's Disease Neuroimaging Initiative, 2015, June. Multiple orderings of events in disease progression. In International Conference on Information Processing in Medical Imaging (pp. 711-722). Springer, Cham.

Theses

- MEng thesis: On a new signature that quantifies topological structure in biological and economic networks. Supervisors: Natasa Przulj, Marek Sergot.
- PhD thesis: Modelling the Neuroanatomical Progression of Alzheimer's Disease and Posterior Cortical Atrophy, arXiv preprint arXiv:2003.04805 (2020). Supervisors: Daniel Alexander, Sebastian Crutch, Neil Oxtoby

Talks

- *Medical Image Generation and Analysis using Bayesian Generative Models*, Stanford University, Computational Neuroscience Laboratory, June 2021
- *Medical Image Generation and Analysis using Bayesian Generative Models*, University of California Santa Cruz, Computer Science Dept, Mar. 2021
- *Medical Image Generation and Analysis using Bayesian Generative Models*, University of British Columbia, Electrical and Computer Engineering Dept., Mar. 2021
- *GAN Tutorial - From basics to current state-of-the-art, and towards key applications in medicine*, Harvard DBMI Clinical Informatics Lecture Series, Sept. 2020

- *Machine learning for prediction and visualisation of brain diseases. Demonstration on Alzheimer's disease*, Boston PyData meetup, Feb. 2020
- *BrainPainter: A software for the visualisation of brain structures, biomarkers and associated pathological processes*, MICCAI MBIA workshop, Nov. 2019
- *TADPOLE Challenge: Accurate Alzheimer's disease prediction through crowdsourced forecasting of future data*, MICCAI PRIME workshop, Nov. 2019
- *Modelling the Neuroanatomical Progression of Alzheimer's Disease and Posterior Cortical Atrophy*, Athinoula A. Martinos Center, Cambridge MA, April 2019
- *A vertex clustering model for disease progression: application to cortical thickness images.* International Conference on Information Processing in Medical Imaging, 2017 (Erbsmann Prize Runner-up)

Review experience

- Computer Vision and Pattern Recognition (CVPR), 2021
- Medical Image Computing and Computer Assisted Surgery (MICCAI), 2018, 2020
- Information Processing in Medical Imaging (IPMI), 2019, 2021
- Neural Information Processing Systems (NeurIPS), 2020
- NeurIPS Machine Learning for Health Workshop (ML4H), 2019
- International Conference on Machine Learning (ICML), 2020
- NeuroImage, 2019
- Conference on Health, Inference, and Learning (CHIL), 2019
- Nature Communications, 2021
- IEEE Transactions on Pattern Analysis and Machine Intelligence (PAMI), 2021
- Alzheimer's and Dementia, 2019, 2020
- Journal of Alzheimer's Disease (JAD), 2019, 2020

News Coverage

- https://www.alzforum.org/news/community-news/tadpole-challenge-seeks-best-predictors-alzheimers
- https://www.alzforum.org/news/community-news/tadpole-challenge-winners-forecast-ad-symptoms
- https://adevarul.ro/locale/cluj-napoca/cercetator-roman-mit-domeniul-inteligentei-artificiale-robotii-vor-mai-multe-sarcini-chirurgii-vor-continua-conduca-operatiile-1_5e4525095163ec42710d3fb8/index.html

Software

- BrainPainter: https://brainpainter.csail.mit.edu/

About me

- Nationality: dual Romanian-British
- Languages spoken: Romanian (native), English (fluent), German (intermediate)
- Programming languages: Python, Java, C++, Haskell, Matlab, Prolog, Assembly x86
- Technical Experience with: Git, Vim, LaTeX, OS programming, Compilers

Exhibit 2

Google Scholar Profile of Dr. Yu Wang

Razvan Marinescu

Postdoctoral Associate,
MIT

Machine Learning
AI
Bayesian Modeling
Healthcare
Computer Vision

	All	Since 2016
Citations	485	483
h-index	10	10
i10-index	10	10

0 articles — 15 articles

not available — available

Based on funding mandates

TITLE	CITED BY	YEAR
Progression of regional grey matter atrophy in multiple sclerosis A Eshaghi, RV Marinescu, AL Young, NC Firth, F Prados, ... Brain 141 (6), 1665-1677	121	2018
Uncovering the heterogeneity and temporal complexity of neurodegenerative diseases with Subtype and Stage Inference A Young, R Marinescu, N Oxtoby, M Bocchetta, K Yong, N Firth, D Cash, ... Nature Communications 9, 4273	101	2018
TADPOLE challenge: Prediction of longitudinal evolution in Alzheimer's disease RV Marinescu, NP Oxtoby, AL Young, EE Bron, AW Toga, MW Weiner, ... arXiv preprint arXiv:1805.03909	69	2018
Longitudinal neuroanatomical and cognitive progression of posterior cortical atrophy NC Firth*, S Primativo*, RV Marinescu*, TJ Shakespeare, ... Brain 142 (7), 2082-2095	37	2019
Multiple orderings of events in disease progression AL Young, NP Oxtoby, J Huang, RV Marinescu, P Daga, DM Cash, ... International Conference on Information Processing in Medical Imaging, 711-722	33	2015
DIVE: A spatiotemporal progression model of brain pathology in neurodegenerative disorders RV Marinescu, A Eshaghi, M Lorenzi, AL Young, NP Oxtoby, S Garbarino, ... NeuroImage 192, 166-177	30	2019
An image-based model of brain volume biomarker changes in Huntington's disease PA Wijeratne, AL Young, NP Oxtoby, RV Marinescu, NC Firth, ... Annals of clinical and translational neurology 5 (5), 570-582	23	2018
A vertex clustering model for disease progression: application to cortical thickness images RV Marinescu, A Eshaghi, M Lorenzi, AL Young, NP Oxtoby, S Garbarino, ... Information Processing in Medical Imaging (Erbsmann prize runner up), 134-145	14	2017
BrainPainter: A software for the visualisation of brain structures, biomarkers and associated pathological processes RV Marinescu, A Eshaghi, DC Alexander, P Golland MICCAI Workshop on Multimodal Brain Image Analysis and Mathematical …	13	2019
The Alzheimer's Disease Prediction Of Longitudinal Evolution (TADPOLE) Challenge: Results after 1 Year Follow-up RV Marinescu, NP Oxtoby, AL Young, EE Bron, AW Toga, MW Weiner, ... arXiv preprint arXiv:2002.03419	10	2020
TADPOLE Challenge: Accurate Alzheimer's Disease Prediction Through Crowdsourced Forecasting of Future Data RV Marinescu, NP Oxtoby, AL Young, EE Bron, AW Toga, MW Weiner, ... MICCAI International Workshop on PRedictive Intelligence In MEdicine, 1-10	9	2019
Uncovering the heterogeneity and temporal complexity of neurodegenerative diseases with subtype and stage inference. Nat Commun 9: 4273 AL Young, RV Marinescu, NP Oxtoby, M Bocchetta, K Yong, NC Firth, ...	7	2018
InSpect: INtegrated SPECTral component estimation and mapping for multi-contrast microstructural MRI PJ Slator, J Hutter, RV Marinescu, M Palombo, AL Young, LH Jackson, ... International Conference on Information Processing in Medical Imaging, 755-766	6	2019
Differences in topological progression profile among neurodegenerative diseases from imaging data S Garbarino, M Lorenzi, NP Oxtoby, EJ Vinke, RV Marinescu, A Eshaghi, ... Elife 8, e49298	5	2019
Predicting Alzheimer's disease progression: Results from the TADPOLE Challenge RV Marinescu, EE Bron, NP Oxtoby, AL Young, AW Toga, MW Weiner, ... Alzheimer's & Dementia 16, e039538	2	2020

TITLE	CITED BY	YEAR
A Data-Driven Comparison of the Progression of Brain Atrophy in Posterior Cortical Atrophy and Alzheimer's Disease RV Marinescu, AL Young, NP Oxtoby, NC Firth, M Lorenzi, A Eshaghi, ... Alzheimer's & Dementia 12, P401-P402	2	2016
Bayesian Image Reconstruction using Deep Generative Models RV Marinescu, D Moyer, P Golland arXiv preprint arXiv:2012.04567	1	2020
Data-Driven Multi-contrast Spectral Microstructure Imaging with InSpect PJ Slator, J Hutter, RV Marinescu, M Palombo, LH Jackson, A Ho, ... International Conference on Medical Image Computing and Computer-Assisted …	1	2020
Disease Knowledge Transfer across Neurodegenerative Diseases RV Marinescu, M Lorenzi, S Blumberg, AL Young, PP Morell, NP Oxtoby, ... Medical Image Computing and Computer Assisted Intervention (MICCAI)	1	2019
Data-Driven multi-Contrast spectral microstructure imaging with InSpect: INtegrated SPECTral component estimation and mapping PJ Slator, J Hutter, RV Marinescu, M Palombo, LH Jackson, A Ho, ... Medical Image Analysis 71, 102045		2021
BrainPainter v2: Mouse Brain Visualization Software V Mallela, P Golland, RV Marinescu arXiv preprint arXiv:2103.14696		2021
Radiomic Signature of White Matter Hyperintensities Is Associated With Clinical Phenotypes M Bretzner, AK Bonkhoff, MD Schirmer, S Hong, AV Dalca, KL Donahue, ...		2021
Show, don't tell: Brain visualisations for neuroimaging studies: Neuroimaging/multi-modal comparisons RV Marinescu, AL Young Alzheimer's & Dementia 16, e041997		2020
Show, don't tell. Brain visualisations for neuroimaging studies RV Marinescu, AL Young 2020 Alzheimer's Association International Conference		2020
Modelling the Neuroanatomical Progression of Alzheimer's Disease and Posterior Cortical Atrophy (PhD thesis) RV Marinescu arXiv preprint arXiv:2003.04805		2020
IC-P-076: GENOMEWIDE ASSOCIATION STUDY OF DATA-DRIVEN ALZHEIMER'S DISEASE SUBTYPES AL Young, MA Scelsi, RV Marinescu, JM Schott, S Ourselin, ... Alzheimer's & Dementia 14 (7S_Part_1), P67-P68		2018
Mechanistic Profiles Of Neurodegeneration: A Study In Alzheimer’s Disease, Healthy Ageing And Primary Progressive Multiple Sclerosis S Garbarino, M Lorenzi, E Vinke, RV Marinescu, NP Oxtoby, A Eshaghi, ... Alzheimer's & Dementia: The Journal of the Alzheimer's Association 14 (7 …		2018
[IC-P-079]: MULTIPLE DISTINCT ATROPHY PATTERNS FOUND IN GENETIC FRONTOTEMPORAL DEMENTIA USING SUBTYPE AND STAGE INFERENCE (SUSTAIN) AL Young, RV Marinescu, NP Oxtoby, M Bocchetta, DM Cash, DL Thomas, ... Alzheimer's & Dementia 13 (7S_Part_1), P65-P66		2017
[P2–414]: CHARACTERISING THE PROGRESSION OF ALZHEIMER's DISEASE SUBTYPES USING SUBTYPE AND STAGE INFERENCE (SUSTAIN) AL Young, RV Marinescu, K Yong, NC Firth, NP Oxtoby, DM Cash, ... Alzheimer's & Dementia 13 (7S_Part_16), P791-P792		2017
Longitudinal Evaluation Of Neuropsychological And Neuroimaging Progression In Posterior Cortical Atrophy S Primativo, RV Marinescu, NC Firth, K Yong, TJ Shakespeare, ... Alzheimer's & Dementia: The Journal of the Alzheimer's Association 13 (7 …		2017
Data-driven Models Of Disease Progression And Applications To Alzheimer’s Disease: Event-based Model And Differential Equation Models Of Biomarker Changes In ADNI NP Oxtoby, AL Young, RV Marinescu, DC Alexander Alzheimer's & Dementia: The Journal of the Alzheimer's Association 13 (7 …		2017

TITLE	CITED BY	YEAR
Analysis Of The Heterogeneity Of Posterior Cortical Atrophy: Data-driven Model Predicts Distinct Atrophy Patterns For Three Different Cognitive Subgroups RV Marinescu, S Primativo, AL Young, NP Oxtoby, NC Firth, A Eshaghi, ... Alzheimer's & Dementia: The Journal of the Alzheimer's Association 13 (7 …		2017
Progression of regional grey matter atrophy in multiple sclerosis A Eshaghi, RV Marinescu, AL Young, NC Firth, F Prados, MJ Cardoso, ... bioRxiv, 190116		2017
MEng Individual Project RV Marinescu Imperial College London		2014

Exhibit 3

Supporting letter and bio from QR, XX Professor of EECS, MIT, United States

Exhibit 4

Supporting letter and bio from Prof. UZ, National University of XYZ

Faculty of Engineering
Department of Electrical & Computer Engineering

13 April, 2021
Department of Homeland Security
United States Citizenship and Immigration Services

Dear USCIS Officer,

I am writing this recommendation letter as an independent reviewer of Dr. Razvan Marinescu's research. Dr. Marinescu is a scientist of extraordinary abilities, and I strongly support his application for a permanent residence in the United States.

I am XXXX, Associate Professor in Electrical and Computer Engineering, and the deputy director of the Centre for XX Research at the National University of XXX. I am also an affiliate faculty member of the Centre for XXXX, the Institute of XXX, and the Institute for XXX at the National University of XXX, as well as the Laboratory for Computational Neuroimaging at XXXX. I serve the research community in various roles, as an editor for the peer-reviewed journals XX and XXX and on the program committee of the Organization of XXXX. I did my B.Sc. and M.Sc. in Electrical Engineering at XXX, and my PhD in Computer Science at the XXXX.

My research aims to study and understand the fundamental principles of brain network organization. My laboratory develops machine learning and artificial intelligence algorithms to automatically generate scientific discoveries from large-scale datasets comprising thousands of subjects with brain magnetic resonance imaging, behavioral, genetic and other physiological measures. My work, particularly in functional connectivity, has been rewarded with multiple prizes, such as the XX Early Career Investigator Award, and I am particularly well known for the creation of XXX, that is used in laboratories world-wide and has received more than 3400 citations to date. My research is received with great interest beyond the expert community and has been featured in the XX, the XX, XX, XX and other popular media. I am a recognized expert in applied machine learning and, like Dr. Marinescu, have also created algorithms for the prediction of Alzheimer's disease and related neurodegenerative diseases. Therefore, I believe I am more than qualified to offer this independent assessment.

I have never met Dr. Marinescu in person, but I am aware of his original scientific contributions to the field of medical artificial intelligence. I have first come in contact with his work in 2017, when my research team decided to participate in TADPOLE, the international challenge Dr. Marinescu organized which aimed to evaluate algorithms that predict the progression of Alzheimer's disease. TADPOLE is a one-of-a-kind challenge and benchmark for comparing a variety of algorithms and methods for the challenging task of predicting Alzheimer's disease, a key neurodegenerative disease affecting millions of people worldwide. While previous algorithms in our research field were all tested on different datasets and with different target variables to be predicted, TADPOLE created a standardized evaluation framework which made all algorithms' performance comparable. Thirty-three international teams from nine different

countries, with approximately three members each, participated in the challenge, and submitted a total of ninety-two prediction algorithms.

Dr. Marinescu has also been the key leader in the organization and running of the TADPOLE Challenge, and played a critical role at various points along the process. He was among the four main organizers (alongside Daniel Alexander, Neil Oxtoby and Alexandra Young) who initially came up with the design of the challenge and created the website detailing the competition, co-created with Neil Oxtoby the datasets for the teams, assisted the teams with running their algorithms and with the tasks they had to solve, solely evaluated and analyzed all the prediction results, and liaised with all the participating teams on accurately synthesizing the description of their algorithms in the final manuscript. Dr. Marinescu presented these results in three scientific articles that already have more than 60 citations. He also presented the final results at the Medical Image Computing and Computer Assisted Surgery (MICCAI) International Conference, the leading venue in medical AI, as well as at the Alzheimer's Association International Conference, the top conference on Alzheimer's disease research.

Through TADPOLE, Dr. Marinescu made a huge scientific contribution to our research field. First, it helped establish how well and how early we can predict Alzheimer's disease with computational algorithms, what are the state-of-the-art algorithms for Alzheimer's disease prediction, and what types of input data are most informative for such predictions. Secondly, Alzheimer's disease is a devastating disease worldwide, with currently more than 50 million people affected, and having associated costs of approximately $100 billion in the United States alone. The ability to detect the disease early, using such AI algorithms, can improve the healthcare management of millions of people worldwide, and also lower the economic costs and caregiver efforts for managing Alzheimer's disease patients.

Dr. Marinescu is also one of the leading experts in disease progression modelling, having published several articles on this topic. First, he published DIVE[1], a novel vertexwise model for learning and clustering temporal trajectories of Alzheimer's disease subjects. The DIVE model was a highly original contribution to the field and was very well-received at the Information Processing for Medical Imaging conference (IPMI), having been nominated for the Francois Erbsmann prize. As an expert in the field, I can attest that IPMI is one of the leading venues in medical image analysis and medical artificial intelligence, and only outstanding contributions are considered for the Francois Erbsmann prize at IPMI. The paper has since gathered 23 citations, and a follow-up model[2] that builds on DIVE has already been implemented by the research team at INRIA, France. In addition, Dr. Marinescu's DIVE article was published in the NeuroImage journal. As the editor of the journal myself, I can confirm that the acceptance standards are very high, with only the best articles being accepted for publication.

[1] Marinescu, Razvan V., et al. "DIVE: A spatiotemporal progression model of brain pathology in neurodegenerative disorders." NeuroImage 192 (2019): 166-177.

[2] Abi Nader, Clement, et al. "Monotonic Gaussian Process for spatio-temporal disease progression modeling in brain imaging data." NeuroImage 205 (2020): 116266.

Dr. Marinescu has also authored other prominent works on disease progression models. The "SuStaIn" model, published in the Nature Communications journal, is a novel technique that can find, within a disease population, multiple sub-populations that progress with different disease patterns. The SuStaIn model discovered that, in Frontotemporal Dementia, the patients with a specific mutation (C9orf72) were actually composed of two distinct groups, instead of a single uniform group as it was believed until that time. Dr. Marinescu also used disease progression models to study not just Alzheimer's disease or Frontotemporal Dementia, but other key neurodegenerative diseases such as Posterior Cortical Atrophy, Multiple Sclerosis and Huntington's Disease, having authored and co-authored more than 4 scientific articles on these neurodegenerative diseases.

As an expert in the field, I can attest that Dr. Marinescu published in the leading journals and conferences in medical AI as well as neurology. The Medical Image Computing and Computer Assisted Surgery (MICCAI) conference, where Dr. Marinescu authored three papers, is the leading venue on theoretical and technical work on artificial intelligence and machine learning for medical applications, having an impact factor of 11.14. On the other hand, the neurology journal "Brain", where Dr. Marinescu authored two articles, one as joint-first author and the other as second author, is the one of the leading journals on neurology and neuroscience, which has been circulating since 1878 and has an impact factor of 11.33.

To conclude, Dr. Marinescu is scientist of extraordinary ability, who has made many contributions to our research field. He is a highly recognized leader in disease progression modeling and artificial intelligence prediction algorithms for medicine, two very important scientific areas. If he is to stay in the United States, he would be a great asset to the country, and can continue to make important new contributions in research and beyond. I therefore urge you to favorably consider his application for permanent residence in the United States.

Very Truly Yours,

XXXXX
Associate Professor, Department of Electrical & Computer Engineering
XXXXXXXX

Exhibit 5

Supporting letter and bio from Prof. GC, Professor of Neuroradiology, XYZ University Medical Center, Country A

To whom it may concern,

This letter is in support of Dr. Marinescu's application for permanent residency in the United States. Dr. Marinescu is an scientist of extraordinary talent with an outstanding reputation, and among the most productive and innovative figures in the field of medical Artificial Intelligence (AI).

I am Professor in XX at the Department of XX at the XXX XXX, XX, and full Professor of XX at the Institute of XXXX. […] I am the Scientific Director of XXX, involved in the analysis of multicentre drug trials. I serve on the Editorial boards of multiple journals, including XXXXX. My research interests focus on Multiple Sclerosis, on dementias such as Alzheimer's disease, and on the normal ageing process.

Through these research activities I have come in contact with Dr. Marinescu on scientific research, being a scientific advisor for the TADPOLE Challenge that he conducted. TADPOLE is the leading international challenge and benchmark of computational models for predicting subjects at risk of Alzheimer's disease. The challenge received a lot of interest from researchers, media and institutions around the world: more than 30 international teams participated with almost 100 different prediction models, was widely featured in the media and received sponsorship from the three main Alzheimer's disease charities Alzheimer's Association, The Alzheimer's Society, and Alzheimer's Research UK. In addition, the contribution of TADPOLE towards the field was immense. In particular, the most surprising result was that while the models could predict the clinical diagnosis and measures from MRI, they could not reliably predict cognitive scores that are routinely used in clinical trials of Alzheimer's disease. This finding has important implications for clinical trials, and also highly impacted the field: many researchers are now working on improving the predictions models for cognitive tests.

Dr. Marinescu has also made highly original contributions in the field of disease progression modelling, having authored and co-authored more than 11 scientific articles on this topic. One of his landmark contributions, the DIVE model, estimated the progression of Alzheimer's brain pathology markers at each location in the brain. In another landmark study Dr. Marinescu co-authored with Dr. Eshaghi, they applied such disease progression models on the largest cohort to date of subjects with Multiple Sclerosis, and found that the brain gray matter is affected in a specific sequence of events that they described. The publications are both well cited, and their models widely used in the research community, with DIVE and its precursor having more than 37 citations, while the Multiple Sclerosis study already receiving more than 104 citations. As one of the world experts in Multiple Sclerosis and Alzheimer's disease, I can confirm that such models are

of crucial importance for identifying the right subjects for clinical trials, and I am aware that pharmaceutical companies are already using their models for the analysis of their imaging data in Alzheimer's disease and Multiple Sclerosis drug trials.

Dr. Marinescu has further made landmark contributions to the study of Posterior Cortical Atrophy, a recently recognized variant of Alzheimer's disease that affects the visual cortex. Dr. Marinescu, through his scientific article published in the journal Brain as well as his PhD thesis, elucidated the temporal progression of Posterior Cortical Atrophy, and showed that it is indeed distinct from that of Alzheimer's disease. He further analysed the progression patterns in three different subgroups of Posterior Cortical Atrophy with different clinical presentations, and showed that these subgroups again have different progression profiles of brain atrophy. These contributions are fundamental for clinical trials in Posterior Cortical Atrophy, and will help the management of all patients suffering from this disorder (~2.5 million people worldwide).

The journals Dr. Marinescu has published in are the leading journals in the field. For example, the journal XXX, […], has a very high acceptance standard, and only the leading scientific articles with major impact to the field are accepted. Other journals such as Nature Communications and NeuroImage also have a similarly high standard. Similarly, the leading international conferences in medical AI, Medical Image Computing and Computer Assisted Intervention (MICCAI) and Information Processing in Medical Imaging (IPMI), also only accept truly novel contributions. In addition, in contrast to conferences that only require abstract submissions, these conferences require articles fully describing the methods and results in their entirety, so publications in MICCAI and IPMI are often comparable to journal publications in their own right.

Dr. Marinescu is a scientific leader of extraordinary ability, who has risen to the very top of the field of medical Artificial Intelligence. His pioneering work on disease progression modelling has influenced many later developments and have led to a better understanding of many neurodegenerative diseases such as Alzheimer's disease, Posterior Cortical Atrophy and Multiple Sclerosis. In addition, through his TADPOLE project, he helped push forward the state-of-the-art AI models for the prediction of Alzheimer's disease. As a XXXX[anonymized role], I can confirm that Artificial Intelligence models such as those developed by Dr. Marinescu will play a pivotal role in future healthcare.

In summary, Dr. Marinescu has made many original contributions of major significance to the field, and will continue to do so in the future. It would thus greatly benefit the United States to have Dr. Marinescu as a permanent resident, and I give my full support to his petition.

Sincerely,

Exhibit 6

Supporting letter and bio from Prof. TF, Professor of Neuropsychology, XYZ

11 May 2021

Dear USCIS officers,

I am writing this recommendation letter on behalf of Dr. Razvan Marinescu for his petition for permanent residency based on his extraordinary abilities. I had the pleasure to be Dr. Marinescu's XX advisor during his PhD at University College London, and have worked with him since 2014. Dr. Marinescu is a scientist of outstanding talent, who has made many contributions of major impact to our research field, and I strongly support his application for residency in the United States.

I am a Professor of XX at the XX, XX, one of the top 3 neuroscience institutes in the world. My research focuses on rare and young onset dementias, especially Posterior Cortical Atrophy (PCA), the so-called "visual variant" of Alzheimer's disease (AD). My work has led to improved understanding of dementia-related visual impairment and the causes and consequences of atypical AD more generally. I was awarded the 2015 Alzheimer's Society Dementia Research Leader Award, and the 2012 British Neuropsychological Society 10th Elizabeth Warrington Prize. I am one of the leading experts on Posterior Cortical Atrophy, having written and contributed more than 78 scientific articles on this disease. In particular, I am the lead author of the Lancet Neurology article from 2012 on Posterior Cortical Atrophy, which has been cited more than 450 times so far and has been the most influential article on this disease since the study of D.F. Tang-Wai in 2004. Given my expertise, I believe I can offer a good account of Dr. Marinescu's contributions to the field, particularly his work on Posterior Cortical Atrophy and other atypical dementias.

Dr. Marinescu, in collaboration with Dr. Firth and Dr. Primativo, authored the first comprehensive longitudinal study on the progression of Posterior Cortical Atrophy. In this landmark study, Dr. Marinescu used Artificial Intelligence models to estimate the evolution of brain atrophy in the largest study population of subjects of Posterior Cortical Atrophy to date. He resolved precisely which brain regions are affected, and in which exact temporal order, which was until then poorly understood. The article, while recently published in 2019, has already been cited more than 32 times. As a leading expert in Posterior Cortical Atrophy, I can certify that this study was of paramount importance for the field: it provided the very first glimpse into the temporal evolution of Posterior Cortical Atrophy, which is necessary for understanding its fundamental mechanisms and for running future clinical trials. In addition, given that most subjects with Posterior Cortical Atrophy are given drug treatments normally given for typical Alzheimer's disease, this study provided strong evidence that Posterior Cortical Atrophy is likely to be a different disease that will require specialised drug treatments compared to typical Alzheimer's disease.

In his PhD thesis as well as the article submitted to the Alzheimer's Association International Conference (AAIC), Dr. Marinescu was among the very first to study the evolution of brain pathology in different subgroups within Posterior Cortical Atrophy. The work done by Dr. Marinescu proved that different clinical symptoms indeed correspond to different brain regions affected. This work is of major importance for future

personalised medicine, as drugs and therapies tailored to specific individuals or subgroups will be more effective and have fewer side effects.

Dr. Marinescu has done outstanding work on brain diseases other than Alzheimer's and Posterior Cortical Atrophy. His seminal work on the Subtype and Stage Inference (SuStaIn) model has revealed the precise variability in brain pathology in patients with Frontotemporal dementia (FTD), and importantly, found that the patients with the C9orf72 mutation are more diverse than previously thought. Dr. Marinescu, together with Dr. Eshaghi, also authored a prominent study on the evolution of Multiple Sclerosis in the largest cohort to date (more than 3000 subjects), which demonstrated that the brain regions in Multiple Sclerosis become affected in a precise sequence that they mapped. Dr. Marinescu has also recently co-authored another study in the Elife journal on the role that brain neural connections play in Multiple Sclerosis and Alzheimer's disease, as well as another publication on the progression of Huntington's disease, a neurodegenerative disease affecting the motor cortex. All these publications highlight the wide remit of Dr. Marinescu's AI models, in particular the disease progression models, that can be applied to many different brain diseases in order to clarify and understand their progression over time. Given the millions of people around the world affected by these diseases, Dr. Marinescu's work is of large impact to society.

Dr. Marinescu authored articles in the leading journals and conferences of the field. Nature Communications, where Dr. Marinescu co-authored the SuStaIn model, is a journal of outstanding research in all areas of natural sciences, with a 2-year impact factor of 12.121. Brain is one of the leading journals on neuroscience and neurology, where Dr. Marinescu published two articles, one as joint-first author. Neuroimage is another leading journal covering research in neuroimaging, with an impact factor of 5.8. Several well-known and prolific authors have published in Neuroimage, including Karl Friston and Arthur W. Toga. In terms of conferences, Dr. Marinescu has published multiple articles in the Medical Image Computing and Computer Assisted Interventions (MICCAI) and Information Processing in Medical Imaging (IPMI) conferences. These are highly technical conferences where key AI experts in medicine, as well as AI and pharmaceutical companies attend. As a clinical researcher in brain diseases, I can confirm that many of the methods published in these two conferences have a strong downstream impact on the medical problems we work on. In addition, Dr. Marinescu has also published with me as well as collaborators three articles at the Alzheimer's Association International Conference (AAIC), and in particular gave an oral presentation on the results of his TADPOLE study. The standard for being invited to give an oral presentation at the AAIC conference is very high, with fewer than 5% of submissions being offered an oral presentation.

Dr. Marinescu has not only published in the leading journals and conferences of the field, but also reviewed the work of other scientists for these journals. This is a crucial service for the research community, as it helps keep the publication standard to a very high quality. I should emphasize that only leading researchers with domain knowledge and expertise are invited to review for such journals and conferences.

Dr. Marinescu has made outstanding contributions of great impact to field of Artificial Intelligence and Machine Learning in Medicine. He is truly among the very top researchers in his field. Following his PhD at University College London, he was invited to pursue his research further at the Massachusetts Institute of Technology in the Computer Science and Artificial Intelligence Laboratory, the world's best research laboratory for his field. I was very fortunate to have worked with him during his PhD, and I am certain his career trajectory will further increase. I strongly support his application for permanent residency in the United States.

Yours sincerely,

Professor of Neuropsychology

Exhibit 7

Supporting letter and bio from TI, Role XYZ, Company XYZ, United States

22nd April 2021

Dear Officers of the United States Citizenship and Immigration Services,

I am very happy to write this letter in support of the petition filed for Dr. Razvan Marinescu based on his extraordinary contributions to the field of medical Artificial Intelligence, and in particular his work on disease progression modelling. Dr. Razvan Marinescu is a scientist of extraordinary ability, and his work has already made a major impact in the research field as well as in the pharmaceutical sector.

I am XXX (MD, PhD), current XX and Head of XXXX at XX. Previously, I was a Medical Director for XX and later Head of XX. During XX, I was a Senior Medical Director for the XXX program and Disease Area Head for XX in Multiple Sclerosis and Neuroscience at XXX. I am also a member of the XX Neurological Society and was an XX Professor of Neurology at the University of XX. I have almost 10 years of XX experience in the biopharmaceutical sector, and have (co)authored more than 140 scientific articles on neuroscience, particularly on Multiple Sclerosis, a demyelinating disease affecting 2.3 million people globally.

I first met Dr. Marinescu in October 2020, when XX, the Director of Artificial Intelligence at XX, invited Dr. Marinescu to present and discuss his work on disease progression modelling. Dr. Marinescu co-authored a highly influential article on a novel disease progression model called SuStaIn, that can identify, within a specific disease, multiple subgroups with different progression profiles. Additionally, Dr. Marinescu has also co-authored another high-profile article on mapping the evolution of neurodegeneration in Multiple Sclerosis using disease progression models. We at XX have been extremely interested in the modelling approach used by Dr. Marinescu, and have used it for our brain imaging data in Multiple Sclerosis. I should highlight that such models are critical for our 5 clinical trials in Alzheimer's disease, as well as our 2 clinical trials in Multiple Sclerosis, as they can predict the disease evolution of individual subjects undergoing the clinical trials, help select the most suitable subjects for going into the trial, and help select the right target measure for evaluating the drug effects. Given the potential to impact all our clinical trials, that incur costs in the order of millions of dollars, our Artificial Intelligence team has implemented and built on Dr. Marinescu's models.

Another influential work by Dr. Marinescu that we have been paying very close attention is the TADPOLE Competition, which compares algorithms at predicting the progression of individuals at risk of Alzheimer's disease. These algorithms are highly useful towards identifying the most suitable patients that can go into our clinical trials, i.e. those that will benefit the most from the drug treatments. This solves one key issue we often face in clinical trials, that of cohort diversity due to different underlying genetics and pathology, which often obscures treatment effects. The computational models from the TADPOLE Challenge can help us select homogeneous groups of patients, thereby increasing the treatment effects in drug trials.

Dr. Marinescu's work on understanding disease progression of Alzheimer's disease and Multiple Sclerosis can have immense implications to enhance the probability of success of transformative drug development at the stage of pivotal clinical trials in those devastating neurological diseases affecting millions of people

Worldwide. There is currently no approved treatment for Alzheimer's disease that can stop cognitive decline, and all clinical trials so far have failed due to wrong treatment targets, wrong patients selected for trials, and difficulty in measuring treatment effects. Through Dr. Marinescu's work, which improves the understanding of such diseases, and could lead to better targets and cohort selection, there is increased hope that disease-modifying treatments will alter the course of Alzheimer's disease in the future.

Dr. Marinescu is a leading scientist who has risen to the very top of the field of medical Artificial Intelligence (AI). His AI models are already used by our research teams at XX, and we are currently keeping a close collaboration with him. In addition, Dr. Marinescu has extraordinary technical skills, as well as a deep fundamental understanding of medical problems. As the XX for XX at XX, who has been involved with recruiting top talent for many years, I can assure you that Dr. Marinescu's skills and contributions are exceptional and only matched by a very small percentage of researchers worldwide.

In summary, I strongly support Dr. Marinescu is his petition for a green card based on his extraordinary abilities in science and the impact of his work. Please do not hesitate to contact me directly if I can provide further information on Dr. Marinescu.

Sincerely,

Exhibit 8

Supporting letter and bio from Dr. DI, Senior Director of XYZ, Company XYZ, United States

April 25, 2021

To whom it may concern,

I write this reference letter in support of Dr. Razvan Marinescu, currently a postdoctoral researcher at the Massachusetts Institute of Technology (MIT), who is petitioning for permanent residence in the United States based on his extraordinary abilities. Dr. Marinescu is an exceptional scientist and leader who has made contributions of major importance to the field, and I strongly support his application.

I am XX, the XXX at XXX.
I manage a team focused on exploratory data analysis and development of prediction models that improve clinical trials. Before moving to XXX, I was the XXX at XXX,
working on assay development projects and discovery of novel biomarkers, which are disease markers used for diagnosis, prognosis and treatment response predictions. I have more than 10 years of experience in XXX in the biopharmaceutical sector. I hold a Diploma in XXXX from the University of XXX
and a doctorate from the University of XX in XXX, and have authored more than 20 scientific articles on novel disease markers and statistical methods for predicting Alzheimer's disease and other diseases.

I first heard of Dr. Marinescu's work in 2017, when our team at XXX decided to participate in the TADPOLE Challenge, which he organized during his PhD at University College London. As part of the challenge, we had to create an algorithm that could automatically predict which subjects, out of a total of 800, would develop Alzheimer's disease in the future. This task was well aligned with our objectives of building computational AI models for early diagnosis of diseases such as Alzheimer's disease. While at XXXXX we had many years of experience with such algorithms, it was not an easy task due to the complexity of the problem. Eventually, we managed to create a good algorithm for making accurate predictions, [XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX]. The impact of the TADPOLE competition in Alzheimer's disease prediction research cannot be overstated: around 30-40 international teams participated in the competition from both academia and the biotech industry, it was backed by the three main Alzheimer's disease charities worldwide (Alzheimer's Association, The Alzheimer's Society and Alzheimer's Research UK), and it entirely reshaped the research field regarding what are the best AI methods for predicting such a disease. In addition, the ability to predict Alzheimer's disease is crucial for our clinical trials at XXXXXXXXX, because we can more accurately screen subjects to undergo such clinical trials, increase the precision of treatment effect estimates by adjusting for explained variability (predicted by the models), and monitor the progression of subjects in our existing trials.

Dr. Marinescu has been an outstanding leader during the organization and running of TADPOLE. He helped all the teams, including ourselves, understand the problem statement, how to use the dataset, and offered us algorithms to get started with. When we had clarifications, we always reached out to him via email or on the forum. He also analyzed and evaluated all our submissions and worked with us to summarize all our technical methods in the final manuscript. He presented the final analysis at the two main conferences in the field, the Medical Image Computing and Computer Assisted Interventions (MICCAI 2019), as well as the Alzheimer's Association International Conference (AAIC 2020), and the results were received with great enthusiasm by the whole research community.

Dr. Marinescu has also published DIVE[1] ("Data-driven Inference of Vertexwise Evolution"), a well-known predictive model of Alzheimer's disease that identifies highly detailed patterns of pathology in the brain. The DIVE model can be used not only to predict the future evolution of Alzheimer's disease subjects, but also to identify new Alzheimer's disease biomarkers that can be used to diagnose the disease and monitor its progression. My team at XXXXX has been working for several years on developing novel biomarkers of Alzheimer's disease, and I can confirm that Dr. Marinescu's work is of fundamental importance for the research field, and had a significant impact on future development of AI prediction models for Alzheimer's disease. It was, for instance, cited more than 24

times, while the precursor[2] to DIVE, also by Dr. Marinescu, was cited more than 14 times so far.

Dr. Marinescu is also very well-known for his work on disease progression models, a specific class of medical AI models which predict not just the diagnosis of a particular patient, but their entire future progression. He worked on several major research projects in this line of research, such as a major study of Multiple Sclerosis, which gathered more than 106 citations so far, and the SuStaIn model, which characterized the disease variability in both Alzheimer's disease and Frontotemporal Dementia, and which gathered more than 85 citations so far. Given the huge burden of such diseases, currently affecting more than 3 million people in the United States alone, and the lack of suitable treatments, the work of Dr. Marinescu is of paramount importance for healthcare in the US and worldwide and can have even more impact in the future due to increasing prevalence of these diseases.

Given his major contributions in the field of medical Artificial Intelligence, in particular through his scientific publications, Dr. Marinescu is truly among the very top of his research field. His work has had significant impact not just in academia, but also in the biopharmaceutical industry, best exemplified by the fact that our company XXXXXXX put together a team to participate in his challenge and build an AI prediction model for Alzheimer's disease. Moreover, his research work has impacted not just Alzheimer's disease, but many other diseases such as Multiple Sclerosis and Frontotemporal dementia, which are major healthcare challenges of our times and into the future.

To conclude, Dr. Marinescu is an outstanding scientist of extraordinary ability in the field of Artificial Intelligence in Medicine. I strongly support his efforts to petition for permanent residency in the United States, and I can guarantee that he will be a valuable asset for the country.

Yours sincerely,

[1] Marinescu, Razvan V., et al. "DIVE: A spatiotemporal progression model of brain pathology in neurodegenerative disorders." NeuroImage 192 (2019): 166-177.

[2] Marinescu, Razvan V, et al. "A vertex clustering model for disease progression: application to cortical thickness images." International conference on Information Processing in Medical Imaging. Springer, Cham, 2017.

Exhibit 9

Supporting letter and bio from Prof. FC, Professor of X, Univ Y, United States

US Customs and Immigration Services April 22, 2021

Dear USCIS representatives:

This is a recommendation letter for Dr. Razvan Marinescu, an applicant for an EB1A visa. I have known Dr. Marinescu for two years while he has been a postdoctoral researcher at the Massachusetts Institute of Technology (MIT). Aside from his scientific research, Dr. Marinescu is an extraordinary leader, who has been the President of the MIT Postdoctoral Association, a key association overseeing all postdoctoral researchers at MIT. Given my involvement in the MIT administration, and my role as XX of the MIT Postdoctoral Association, I am very happy to provide this recommendation letter for Dr. Marinescu.

I a Professor of XX at MIT and former Head of the XXX during XX. I am a XX whose research lies in XXX. I served as MIT's XXXX from XXX, and have served on numerous national committees and task forces on XXX. ... During the past 3 years, I have also served as XX to the MIT Postdoctoral Association, so I am highly familiar with their work and impact across the research community at MIT.

The MIT Postdoctoral Association (PDA) is an organization that supports MIT postdoctoral researchers during their professional research and career development. The Association oversees all postdoctoral researchers at MIT, currently numbering more than 1500, who are spread across more than 50 research centers and institutes across MIT. The association serves as a liaison between postdoctoral researchers and the faculty and administration of MIT, and strives to engage with and improve the MIT community. The MIT PDA aims to enhance all aspects of the postdoctoral research experience and to foster a sense of community which promotes and encourages an environment of peer support. The MIT PDA has an Executive Board which is responsible for the general operations, and is currently composed of five executive officers: President, Vice President, Treasurer, Corresponding Secretary and Recording Secretary. The association also comprises a standing committee of around nine additional officers, responsible for fulfilling specific responsibilities. The MIT PDA is governed by a constitution, which was last ratified in 2012.

Given all the functions and responsibilities that the Postdoctoral Association has, its role is of critical importance for all postdoctoral researchers at MIT, and for MIT altogether. In contrast to local postdoctoral associations specific to a particular MIT department or laboratory, the MIT Postdoctoral Association is the only organization that represents all postdoctoral researchers across all departments within MIT, so it's work has a broad impact across the entire Institute. To highlight how important the PDA is for MIT, the organization managed over the last few years to increase the benefits of Postdoctoral Fellows, those postdoctoral researchers with funding from outside MIT but who otherwise conduct research at MIT, to match those of Postdoctoral Associates, who are currently funded by MIT. While Postdoctoral Fellows, who represent 30% of all postdoctoral researchers, did not previously have subsidized health insurance, retirement benefits, and subsidized access to public transportation, due to the efforts of the MIT PDA they are now able to enjoy all these benefits just like the rest of the postdoctoral researchers.

Dr. Marinescu was initially elected in August 2019 as Vice President of the PDA by the MIT postdoctoral researchers. However, two months later, due to the previous President having to unexpectedly leave the role, Dr. Marinescu was voted by the PDA board as the new President. While this was a significant increase in his responsibilities, Dr. Marinescu very quickly learned the PDA organizational structure, its constitution and bylaws, and how to lead the organization. I should emphasize that obtaining such an executive role in the Postdoctoral Association is extremely difficult, as anyone of the 1500 postdoctoral researchers at MIT can stand for election, and the candidates each need to prepare a clear manifesto outlining solutions to key problems, and convince all other postdoctoral researchers to vote them. Prior leadership experience is also essential to be elected in such a role.

In the role of PDA president, Dr. Marinescu had significant responsibilities. He presided, chaired and set the agenda for all General Meetings, acted as a liaison between the MIT PDA and the Office of the Vice President for Research, acted as a representative of MIT PDA in the Faculty Postdoc Advisory Committee. Internally, he was responsible for the overall condition of the Postdoctoral Association, ensured that all other officer positions are filled, and coordinated the training of incoming officers. The PDA President role is very demanding, as it involves organizing and running a board of 15-20 PDA officers, representing all MIT postdoctoral researchers, currently numbering more than 1500, in faculty meetings and externally outside MIT, and listening to the needs of postdoctoral researchers and working with the PDA board to find solutions.

During his tenure, Dr. Marinescu, as PDA President, was also on the hiring committee for the new MIT Institute Community and Equity Officer (ICEO), which selected in February 2020 John Dozier, an experienced higher-education leader, in the role. Given that XXXXXXXXXXXXXXX, I can confirm that the ICEO is a critical role at MIT, and reports straight to the Provost, Martin A. Schmidt, with a mandate to develop and implement diversity and inclusion strategies for the institute.

Under the leadership of Dr. Marinescu, the MIT Postdoctoral Association has had many accomplishments and launched many initiatives for all postdoctoral researchers at MIT. It ran several new career development programs, such as a six-month mentorship program for postdocs interested in academia or industry, several panel discussions on topics regarding academic research and future career pathways, and also launched a new Diversity, Equity and Inclusion journal club, where MIT postdoctoral researchers discussed scientific articles on diversity and inclusion topics. They also

started collaborations with other Postdoctoral Associations, such as the Boston-Area PDA, as well as the Harvard PDA. Perhaps one of the most important initiatives undertaken by Dr. Marinescu was to organize a session where 10 representative postdoctoral researchers across MIT met with 15 members of the MIT Corporation who were visiting the office of the Vice President for Research, in order to give them feedback about postdoctoral academic life. The session had a major impact for all postdoctoral researchers at MIT, as it provided the required impetus to address multiple problems, in particular regarding housing affordability and general living expenses.

As PDA President, Dr. Marinescu also led new directions of advocacy for the PDA. During his tenure, the PDA started advocating on key issues facing postdoctoral researchers at MIT: the ability to find affordable housing, increased childcare support for researchers with children, improved career development programs, and more opportunities for interaction and collaboration between postdoctoral researchers across different institutes at MIT. These directions have been identified after discussing with a broad range of postdoctoral researchers across MIT, in order to understand their needs.

To conclude, Dr. Marinescu, as PDA President, undertook a highly important role with significant responsibilities for the postdoctoral researchers at MIT. The programs and initiatives launched by the PDA have greatly improved the experience of all postdoctoral researchers at MIT. I am certain that Dr. Marinescu will build on this success in leadership roles within academia or other distinguished organizations in the future. Given the need for such talented leadership in the United States, it would be of paramount importance to allow Dr. Marinescu to continue his leadership and research work here. I strongly support his petition for permanent residence, and hope he will get a favorable reply.

Sincerely,

Exhibit 10

First pages of a peer-reviewed publication authored by Dr. Marinescu on Posterior Cortical Atrophy [excluded], alongside his PhD thesis focusing on Posterior Cortical Atrophy

Modelling the Neuroanatomical Progression of Alzheimer's Disease and Posterior Cortical Atrophy

Author:
Răzvan V. Marinescu

Supervisors:
Prof. Daniel C. Alexander
Dr. Sebastian Crutch
Dr. Neil P. Oxtoby

A dissertation submitted in partial fulfillment
of the requirements for the degree of

Doctor of Philosophy

of

University College London

Centre for Medical Image Computing, University College London

Defense date: January 23, 2019

Abstract

In order to find effective treatments for Alzheimer's disease (AD), a devastating neurodegenerative disease affecting millions of people worldwide, we need to identify subjects at risk of AD as early as possible. To this end, recently developed disease progression models can be used to perform early diagnosis, as well as predict the subjects' disease stages and future evolution. However, these models have not yet been applied to rare neurodegenerative diseases, are not suitable to understand the complex dynamics of biomarkers, work only on large multimodal datasets, and their predictive performance has not been objectively validated.

In this work I developed novel models of disease progression and applied them to estimate the progression of Alzheimer's disease and Posterior Cortical atrophy, a rare neurodegenerative syndrome causing visual deficits. My first contribution is a study on the progression of Posterior Cortical Atrophy, using models already developed: the Event-based Model (EBM) and the Differential Equation Model (DEM). My second contribution is the development of DIVE, a novel spatio-temporal model of disease progression that estimates fine-grained spatial patterns of pathology, potentially enabling us to understand complex disease mechanisms relating to pathology propagation along brain networks. My third contribution is the development of Disease Knowledge Transfer (DKT), a novel disease progression model that estimates the multimodal progression of rare neurodegenerative diseases from limited, unimodal datasets, by transferring information from larger, multimodal datasets of typical neurodegenerative diseases. My fourth contribution is the development of novel extensions for the EBM and the DEM, and the development of novel measures for performance evaluation of such models. My last contribution is the organization of the TADPOLE challenge, a competition which aims to identify algorithms and features that best predict the evolution of AD.

Contents

Exhibit 11

First pages of 3 peer-reviewed publications authored by Dr. Marinescu on the TADPOLE Challenge, alongside a media article from Alzforum on the results of the Challenge

- Marinescu, Razvan V., et al. "Tadpole Challenge: Prediction of longitudinal evolution in Alzheimer's disease." arXiv preprint arXiv:1805.03909 (2018).
- Marinescu, Razvan V., et al. "The Alzheimer's Disease Prediction Of Longitudinal Evolution (TADPOLE) Challenge: Results after 1 Year Follow-up." arXiv preprint arXiv:2002.03419 (2020).
- Marinescu, Razvan V., et al. "TADPOLE Challenge: Accurate Alzheimer's disease prediction through crowdsourced forecasting of future data.", International Workshop on PRedictive Intelligence In MEdicine Springer, MICCAI, Cham, 2019.
- Media article from Alzforum about the results and findings of the TADPOLE Challenge: https://www.alzforum.org/news/community-news/tadpole-challenge-winners-forecast-ad-symptoms
- Wikipedia article about Alzforum, an independent, non-profit website and community for accelerating research in Alzheimer's disease.

TADPOLE Challenge: Winners Forecast AD Symptoms

19 Jun 2019

Results are in for the TADPOLE Challenge—a prize contest that invited researchers to come up with their own ways of predicting dementia symptoms in participants enrolled in the Alzheimer's Disease Neuroimaging Initiative (ADNI). In a live webinar on June 14, organizers announced who came out ahead. Contestants had submitted computer code to forecast the clinical status, cognitive scores, and/or imaging characteristics of ADNI3 participants. Once submissions were in, the data were collected and results tabulated. The best methods garnered prize money in the amount of £30,000, donated by the Alzheimer's Society in London, Alzheimer's Research U.K., and the Alzheimer's Association.

- Winners of the TADPOLE challenge took home £5,000 to £10,000 each.
- Their codes predicted clinical status and ventricular volume in ADNI3.
- "Consensus scores" outperformed any single entry.

"The challenge results give a snapshot of current capabilities in predicting progression and conversion," wrote co-organizer Daniel Alexander, University College London, to Alzforum. "Current technology can add useful predictions of some variables, such as clinical status and ventricular volume. In other tasks, such as estimating future cognitive scores, current methods struggle."

Announced in June of 2017, the TADPOLE Challenge, short for The Alzheimer's Disease Prediction of Longitudinal Evolution, is a collaboration between the European Progression of Neurological Disease (EuroPOND) consortium and ADNI (Jul 2017 news). Contestants used the longitudinal data sets of ADNI1, ADNIGO, and ADNI2 to develop ways to predict one or all of the following three features in ADNI3 data:

- A participant's clinical status (normal, mild cognitive impairment, or probable AD),
- Score on the Alzheimer's Disease Assessment Scale-Cognitive (ADAS-Cog),
- Ventricular volume measured by magnetic resonance imaging (MRI) scans.

By November 2017, 33 teams had submitted a range of methods. Contestants came from Australia, Canada, Europe, Israel, Mexico, Singapore, the U.K. and the U.S.. Most were early career researchers in teams at universities, biotech companies, even high school.

"We received a lot of enthusiasm from challenge participants," wrote Neil Oxtoby, also at UCL. "Professors told us of excitement from their Ph.D. students and postdocs, who loved the high-impact motivation of improving clinical trials, the unique design of forecasting, and the fun, competitive nature complete with prize pool."

Baseline data collection from ADNI3 wrapped up in March 2019. TADPOLE organizers downloaded that data, which came from 219 participants who rolled over to ADNI3 from a previous ADNI phase. Then they evaluated which contest submissions most closely predicted the different outcomes. The winners from each category took home £5,000.

For clinical status, the winning team was led by Keli Liu, Stanford University, who was working with a team at Genentech at the time. Combining longitudinal cognitive test scores, clinical diagnosis, regional brain imaging markers, APOE status, and cerebrospinal fluid biomarkers into a machine-learning approach, these scientists achieved an impressive area under the curve of

0.931. This team also took the prize for best overall TADPOLE submission, using their method to score among the top 10 teams across all three categories. This clinical status category saw additional prizes, for a high school team led by Gang Chen, Medical College Wisconsin, and a university team led by Manon Ansart from the Brain and Spinal Cord Institute, Paris.

For ventricular volume, the winning group was Vikram Venkatraghavan's. He is now a Ph.D. student at Erasmus MC, Rotterdam, the Netherlands, after working as an engineer for some years. Venkatraghavan and colleagues built a combined machine-learning and disease-progression model using both manually and automatically selected longitudinal features from ADNI. Their method predicted ventricle volume with the lowest mean absolute error.

Alas, the ADAS-Cog score resisted prediction. No submission did better than chance, so the organizers gave no prize in this category and reallocated the spoils to two other teams. One half went to the runner-up in the high school category, a group from the Vasile Lucaciu National College in Baia Mare, Romania. The other went to a team led by Steven Hill at the University of Cambridge that used only the most recent cross-sectional measurement from ADNI to forecast values for ADNI3. Their statistical-regression and disease-progression model forecast the ADNI3 measures with the greatest overall precision among entrants who used only cross-sectional ADNI data. Such a method would be most useful in the clinic and for trials, as it enables a likely prognosis for a given person from a single evaluation, rather than requiring longitudinal data and knowledge about their prior rates of change.

Fully understanding the challenge's findings will require additional analysis, but some preliminary observations jump out. For one, averaging all teams' forecasts for each measurement into a "consensus" score far outperformed any individual entry. In other words, many heads were better than one. "Such a finding is only possible through an initiative like TADPOLE, where we pull the community together to submit forecasts on the same task using diverse kinds of methods," Alexander wrote to Alzforum. "It suggests industry might consider crowd-sourcing models with appropriate incentives to get the most robust and reliable predictions."

For another, ApoE status, CSF biomarkers, and diffusion tensor imaging seemed most informative for future forecasts, while PET measurements of tau, amyloid, or FDG uptake were less helpful.

Organizers are encouraging the participating teams to share their project code publicly. Alexander believes that these methods can be a starting point from which the research community develops ways to make even more robust predictions.—Gwyneth Dickey Zakaib

COMMENTS

No Available Comments

Make a Comment

To make a comment you must login or register.

REFERENCES

News Citations

TADPOLE Challenge Seeks Best Predictors of Alzheimer's 12 Jul 2017

External Citations

webinar

TADPOLE Challenge

FURTHER READING

Papers

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News

NIA Seeks Community Input on Alzheimer's Eureka Prize 10 Nov 2017

α-Synuclein Antibodies Enter Phase 2, Sans Biomarker 6 May 2017

De Strooper, Goedert, Hardy, Haass Share 2018 Brain Prize 8 Mar 2018

Bu, Kivipelto, Cirrito, and Slutsky Win MetLife Awards 25 Jul 2016

WIKIPEDIA

Alzheimer Research Forum

Alzheimer Research Forum (ARF), or **Alzforum** is a website which uses web technology to accelerate research into Alzheimer's disease.

Contents

History

The website was founded in 1996 by June Kinoshita, funded by an anonymous philanthropic foundation, and launched at the International Conference on Alzheimer's Disease and Related Disorders in Osaka, Japan, The forum brings together a team of specialists in science writing and editing, data curation, information architecture, project management and technology.

Alzforum was established as an independent neutral Non-profit organization, without affiliation to any specific university or research institute. Its relations with the scientific community include an advisory board with leaders in the scientific community representing diverse points of view.

At first the site took the form of 'Papers of the Week' listings, including abstracts of all relevant publications (initially manually produced in order to avoid copyright infringement), commentary, virtual audio seminars, and a list of seminal papers in Alzheimer's research. The Web's potential for interactivity was used for informal live chats and commentary on papers by registered users of the site. By the end of the first year there were 1200 users, adding as many as 100 new users a month in the first years of its existence.

Operations

From 1997, the website also began to develop as a community repository, enabling researchers to deposit data sets. Currently it maintains several databases relating to gene mutations, gene association studies, epidemiological studies, antibodies, drug trials, protocols and antecedent biomarker studies. Of particular note are the AlzGene database of genetic studies of Alzheimer's disease, which has been cited more than 1,200 times in the scientific literature, and the AlzRisk database of epidemiologic studies. The forum acts as an integrator of these diverse sources, linking primary research articles to related news, papers, databases, and discussions .

From 2000 onwards a data-driven dynamic system has been used to automatically search and download PubMed citations into a database, and provide tools for editors to post news and comments and crosslink them to related material. The development of semantic web tools is a current and ongoing development. These assist in the identification of hypotheses and related evidence in papers and discussions. SWAN (Semantic Web Applications in Neuromedicine) has resulted from a collaboration between the forum and Massachusetts General Hospital. Work on this continues with the Scientific Collaboration Framework.

The forum has become a point of reference for researchers into AD. As of June 2013 it has more than 8300 registered users. It is estimated that 30-50% of researchers from a wide range of institutions and countries studying Alzheimer's internationally are registered or active on the site.

The success of Alzforum has resulted in its online disease-specific scientific community framework being cloned in other areas of research into neurological disorders. Multiple Sclerosis Discovery Forum, Pain Research Forum, Schizophrenia Research Forum and PD Online (a site for research into Parkinson's disease, funded by the Michael J. Fox Foundation) are using the same approach[1] as Alzforum.

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External links

- AlzForum [1] (http://www.alzforum.org/)

Exhibit 12

First pages of 2 peer-reviewed publications authored by Dr. Marinescu on the DIVE model, that estimates the progression of Alzheimer's disease

NeuroImage 192 (2019) 166–177

Contents lists available at ScienceDirect

NeuroImage

journal homepage: www.elsevier.com/locate/neuroimage

DIVE: A spatiotemporal progression model of brain pathology in neurodegenerative disorders

Răzvan V. Marinescu [a,*], Arman Eshaghi [b], Marco Lorenzi [a,c], Alexandra L. Young [a], Neil P. Oxtoby [a], Sara Garbarino [a,c], Sebastian J. Crutch [d], Daniel C. Alexander [a], for the Alzheimer's Disease Neuroimaging Initiative

[a] Centre for Medical Image Computing, University College London, Gower Street, London, United Kingdom
[b] Queen Square Multiple Sclerosis Centre, UCL Institute of Neurology, Faculty of Brain Sciences, University College London, United Kingdom
[c] Epione Research-Project, Inria, France and Université Côte D'Azur, France
[d] Dementia Research Centre, University College London Institute of Neurology, London, United Kingdom

ARTICLE INFO

Keywords:
Disease progression model
Cortical thickness
Vertex-wise measures
Alzheimer's disease
Posterior cortical atrophy

ABSTRACT

Current models of progression in neurodegenerative diseases use neuroimaging measures that are averaged across pre-defined regions of interest (ROIs). Such models are unable to recover fine details of atrophy patterns; they tend to impose an assumption of strong spatial correlation within each ROI and no correlation among ROIs. Such assumptions may be violated by the influence of underlying brain network connectivity on pathology propagation – a strong hypothesis e.g. in Alzheimer's Disease. Here we present DIVE: **D**ata-driven **I**nference of **V**ertexwise **E**volution. DIVE is an image-based disease progression model with single-vertex resolution, designed to reconstruct long-term patterns of brain pathology from short-term longitudinal data sets. DIVE clusters vertex-wise (i.e. point-wise) biomarker measurements on the cortical surface that have similar temporal dynamics across a patient population, and concurrently estimates an average trajectory of vertex measurements in each cluster. DIVE uniquely outputs a parcellation of the cortex into areas with common progression patterns, leading to a new signature for individual diseases. DIVE further estimates the disease stage and progression speed for every visit of every subject, potentially enhancing stratification for clinical trials or management. On simulated data, DIVE can recover ground truth clusters and their underlying trajectory, provided the average trajectories are sufficiently different between clusters. We demonstrate DIVE on data from two cohorts: the Alzheimer's Disease Neuroimaging Initiative (ADNI) and the Dementia Research Centre (DRC), UK. The DRC cohort contains patients with Posterior Cortical Atrophy (PCA) as well as typical Alzheimer's disease (tAD). DIVE finds similar spatial patterns of atrophy for tAD subjects in the two independent datasets (ADNI and DRC), and further reveals distinct patterns of pathology in different diseases (tAD vs PCA) and for distinct types of biomarker data – cortical thickness from Magnetic Resonance Imaging (MRI) vs amyloid load from Positron Emission Tomography (PET). We demonstrate that DIVE stages have potential clinical relevance, despite being based only on imaging data, by showing that the stages correlate with cognitive test scores. Finally, DIVE can be used to estimate a fine-grained spatial distribution of pathology in the brain using any kind of voxelwise or vertexwise measures including Jacobian compression maps, fractional anisotropy (FA) maps from diffusion tensor imaging (DTI) or other PET measures.

1. Introduction

Many biomarkers exist that can be used to track the severity of neurodegenerative diseases such as Alzheimer's disease (AD). Clinical function can be measured using cognitive assessments performed by an expert clinician and brain atrophy can be measured using Magnetic Resonance Imaging (MRI). Other measures include molecular markers such as aggregation of misfolded amyloid-beta or tau measured using Positron Emission Tomography (PET), and measures of white-matter degradation such as fractional anisotropy (FA) from Diffusion Tensor Imaging (DTI). The evolution of these biomarkers across the disease time-course creates a unique signature of the disease that can be used to stage

* Corresponding author. Engineering Front Building, Torrington Place, London, WC1E 7JE, United Kingdom.
E-mail address: razvan.marinescu.14@ucl.ac.uk (R.V. Marinescu).

https://doi.org/10.1016/j.neuroimage.2019.02.053
Received 25 June 2018; Received in revised form 18 February 2019; Accepted 20 February 2019
Available online 4 March 2019

A vertex clustering model for disease progression: Application to cortical thickness images

Răzvan V. Marinescu[1], Arman Eshaghi[1,2], Marco Lorenzi[1,4], Alexandra L. Young[1], Neil P. Oxtoby[1], Sara Garbarino[1], Timothy J. Shakespeare[3], Sebastian J. Crutch[3], and Daniel C. Alexander[1], for the Alzheimers Disease Neuroimaging Initiative*

[1] Centre for Medical Image Computing, Computer Science Department, University College London, UK
[2] Queen Square MS Centre, UCL Institute of Neurology, London
[3] Dementia Research Centre, UCL Institute of Neurology, University College London, UK
[4] University of Côte d'Azur, Inria Sophia Antipolis, Asclepios Research Project

Abstract. We present a disease progression model with single vertex resolution that we apply to cortical thickness data. Our model works by clustering together vertices on the cortex that have similar temporal dynamics and building a common trajectory for vertices in the same cluster. The model estimates optimal stages and progression speeds for every subject. Simulated data show that it is able to accurately recover the vertex clusters and the underlying parameters. Moreover, our clustering model finds similar patterns of atrophy for typical Alzheimer's disease (tAD) subjects on two independent datasets: the Alzheimer's Disease Neuroimaging Initiative (ADNI) and a cohort from the Dementia Research Centre (DRC), UK. Using a separate set of subjects with Posterior Cortical Atrophy (PCA) from the DRC dataset, we also show that the model finds different patterns of atrophy in PCA compared to tAD. Finally, our model also provides a novel way to parcellate the brain based on disease dynamics.

Keywords: Disease Progression Model, Cortical Thickness, Vertex-wise Measures, Alzheimer's Disease, Posterior Cortical Atrophy

1 Introduction

During the progression of Alzheimer's disease, many biomarkers based on Magnetic Resonance Imaging (MRI) such as cortical thickness become abnormal at

* Data used in preparation of this article were obtained from the Alzheimer's Disease Neuroimaging Initiative (ADNI) database (adni.loni.usc.edu). As such, the investigators within the ADNI contributed to the design and implementation of ADNI and/or provided data but did not participate in analysis or writing of this report. A complete listing of ADNI investigators can be found at: http://adni.loni.usc.edu/wp-content/uploads/how_to_apply/ADNI_Acknowledgement_List.pdf

Exhibit 13

First pages of 2 peer-reviewed publications authored by Dr. Marinescu on disease progression modelling of Multiple Sclerosis and Frontotemporal dementia

doi:10.1093/brain/awy088 BRAIN 2018: 141; 1665–1677 | 1665

BRAIN
A JOURNAL OF NEUROLOGY

Progression of regional grey matter atrophy in multiple sclerosis

Arman Eshaghi,[1,2] Razvan V. Marinescu,[2] Alexandra L. Young,[2] Nicholas C. Firth,[2] Ferran Prados,[3] M. Jorge Cardoso,[3] Carmen Tur,[1] Floriana De Angelis,[1] Niamh Cawley,[1] Wallace J. Brownlee,[1] Nicola De Stefano,[5] M. Laura Stromillo,[5] Marco Battaglini,[5] Serena Ruggieri,[6,7] Claudio Gasperini,[6] Massimo Filippi,[8] Maria A. Rocca,[8] Alex Rovira,[9] Jaume Sastre-Garriga,[10] Jeroen J. G. Geurts,[11] Hugo Vrenken,[12] Viktor Wottschel,[12] Cyra E. Leurs,[13] Bernard Uitdehaag,[13] Lukas Pirpamer,[14] Christian Enzinger,[14,15] Sebastien Ourselin,[3,4] Claudia A. Gandini Wheeler-Kingshott,[1,16,17] Declan Chard,[1,4] Alan J. Thompson,[1] Frederik Barkhof,[1,3,4,12] Daniel C. Alexander[2] and Olga Ciccarelli[1,4] on behalf of the MAGNIMS study group*

*Appendix 1.

See Stankoff and Louapre (doi:10.1093/brain/awy114) for a scientific commentary on this article.

Grey matter atrophy is present from the earliest stages of multiple sclerosis, but its temporal ordering is poorly understood. We aimed to determine the sequence in which grey matter regions become atrophic in multiple sclerosis and its association with disability accumulation. In this longitudinal study, we included 1417 subjects: 253 with clinically isolated syndrome, 708 with relapsing-remitting multiple sclerosis, 128 with secondary-progressive multiple sclerosis, 125 with primary-progressive multiple sclerosis, and 203 healthy control subjects from seven European centres. Subjects underwent repeated MRI (total number of scans 3604); the mean follow-up for patients was 2.41 years (standard deviation = 1.97). Disability was scored using the Expanded Disability Status Scale. We calculated the volume of brain grey matter regions and brainstem using an unbiased within-subject template and used an established data-driven event-based model to determine the sequence of occurrence of atrophy and its uncertainty. We assigned each subject to a specific event-based model stage, based on the number of their atrophic regions. Linear mixed-effects models were used to explore associations between the rate of increase in event-based model stages, and T_2 lesion load, disease-modifying treatments, comorbidity, disease duration and disability accumulation. The first regions to become atrophic in patients with clinically isolated syndrome and relapse-onset multiple sclerosis were the posterior cingulate cortex and precuneus, followed by the middle cingulate cortex, brainstem and thalamus. A similar sequence of atrophy was detected in primary-progressive multiple sclerosis with the involvement of the thalamus, cuneus, precuneus, and pallidum, followed by the brainstem and posterior cingulate cortex. The cerebellum, caudate and putamen showed early atrophy in relapse-onset multiple sclerosis and late atrophy in primary-progressive multiple sclerosis. Patients with secondary-progressive multiple sclerosis showed the highest event-based model stage (the highest number of atrophic regions, $P < 0.001$) at the study entry. All multiple sclerosis phenotypes, but clinically isolated syndrome, showed a faster rate of increase in the event-based model stage than healthy controls. T_2 lesion load and disease duration in all patients were associated with increased event-based model stage, but no effects of disease-modifying treatments and comorbidity on event-based model stage were observed. The annualized rate of event-based model stage was associated with the disability accumulation in relapsing-remitting multiple sclerosis, independent of disease duration ($P < 0.0001$). The data-driven staging of atrophy progression in a large multiple sclerosis sample demonstrates that grey matter atrophy spreads to involve more regions over time. The sequence in which regions become atrophic is reasonably consistent across multiple sclerosis phenotypes. The spread of atrophy was associated with disease duration and with disability accumulation over time in relapsing-remitting multiple sclerosis.

Received September 22, 2017. Revised December 24, 2017. Accepted February 9, 2018. Advance Access publication May 8, 2018

nature COMMUNICATIONS

ARTICLE

DOI: 10.1038/s41467-018-05892-0 OPEN

Uncovering the heterogeneity and temporal complexity of neurodegenerative diseases with Subtype and Stage Inference

Alexandra L Young et al.#

The heterogeneity of neurodegenerative diseases is a key confound to disease understanding and treatment development, as study cohorts typically include multiple phenotypes on distinct disease trajectories. Here we introduce a machine-learning technique—Subtype and Stage Inference (SuStaIn)—able to uncover data-driven disease phenotypes with distinct temporal progression patterns, from widely available cross-sectional patient studies. Results from imaging studies in two neurodegenerative diseases reveal subgroups and their distinct trajectories of regional neurodegeneration. In genetic frontotemporal dementia, SuStaIn identifies genotypes from imaging alone, validating its ability to identify subtypes; further the technique reveals within-genotype heterogeneity. In Alzheimer's disease, SuStaIn uncovers three subtypes, uniquely characterising their temporal complexity. SuStaIn provides fine-grained patient stratification, which substantially enhances the ability to predict conversion between diagnostic categories over standard models that ignore subtype ($p = 7.18 \times 10^{-4}$) or temporal stage ($p = 3.96 \times 10^{-5}$). SuStaIn offers new promise for enabling disease subtype discovery and precision medicine.

Correspondence and requests for materials should be addressed to A.L.Y. (email: alexandra.young@ucl.ac.uk). A full list of authors and their affiliations appears at the end of the paper.

Author contributions

A.L.Y., D.C.A., J.D.R. and J.M.S. conceived and designed the experiments and wrote the manuscript. A.L.Y. implemented the programming code and analysed the data. N.P.O. and R.V.M. provided feedback on the experiment design. R.V.M. made the brain images in Figs. 1–4, 6 and Supplementary Figures 13–14. M.B. derived the asymmetry measure for GENFI participants. K.Y. advised on sub-scores of the ADAS related to praxic, spatial and memory domains. Members of the ADNI and GENFI consortia recruited patients and collected and pre-processed data. All authors contributed to reviewing and editing of the report.

Additional information

Supplementary Information accompanies this paper at https://doi.org/10.1038/s41467-018-05892-0.

Competing interests: The authors declare no competing interests.

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Alexandra L Young[1,2], Razvan V Marinescu[1,2], Neil P Oxtoby[1,2], Martina Bocchetta[3], Keir Yong[3], Nicholas C Firth[1,2], David M Cash[1,3], David L Thomas[4,5], Katrina M Dick[3], Jorge Cardoso[1,3,6], John van Swieten[7], Barbara Borroni[8], Daniela Galimberti[9,10], Mario Masellis[11], Maria Carmela Tartaglia[12], James B Rowe[13], Caroline Graff[14], Fabrizio Tagliavini[15], Giovanni B Frisoni[16], Robert Laforce Jr[17], Elizabeth Finger[18], Alexandre de Mendonça[19], Sandro Sorbi[20,21], Jason D Warren[3], Sebastian Crutch[3], Nick C Fox[3], Sebastien Ourselin[1,3,4,6], Jonathan M Schott[3], Jonathan D Rohrer[3], Daniel C Alexander[1,2], The Genetic FTD Initiative (GENFI) & The Alzheimer's Disease Neuroimaging Initiative (ADNI)

[1]Centre for Medical Image Computing, University College London, London WC1E 6BT, UK. [2]Department of Computer Science, University College London, London WC1E 6BT, UK. [3]Dementia Research Centre, Institute of Neurology, University College London, London WC1N 3BG, UK. [4]Leonard Wolfson Experimental Neurology Centre, UCL Institute of Neurology, University College London, London WC1N 3BG, UK. [5]Neuroradiological Academic Unit, Department of Brain Repair and Rehabilitation, UCL Institute of Neurology, University College London, London WC1N 3BG, UK. [6]School of Biomedical Engineering and Imaging Sciences, King's College London, London WC2R 2LS, UK. [7]Erasmus Medical Center, 3000 CA Rotterdam, The Netherlands. [8]Neurology Unit, Department of Clinical and Experimental Sciences, University of Brescia, 25121 Brescia, Italy. [9]Dept. of Physiopathology and Transplantation, University of Milan, Centro Dino Ferrari, 20122 Milan, Italy. [10]Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico, via F. Sforza, 35, 20122 Milan, Italy. [11]Sunnybrook Health Sciences Centre, University of Toronto, ON M4N 3M5, Canada. [12]Centre for Research in Neurodegenerative Diseases, University of Toronto, ON, Toronto M5T 0S8, Canada. [13]University of Cambridge, Department of Clinical Neurosciences, Cambridge CB2 0SZ, UK. [14]Karolinska Institutet, 171 77 Solna, Sweden. [15]Istituto Neurologico Carlo Besta, 20133 Milan, Italy. [16]University Hospitals and University of Geneva, Geneva, Switzerland. [17]Université Laval, Quebec, QC G1V 0A6, Canada. [18]University of Western Ontario, London, ON N6A 3K7, Canada. [19]Faculdade de Medicina, Universidade de Lisboa, 1649-028 Lisboa, Portugal. [20]Department of Neuroscience, Psychology, Drug Research and Child Health, University of Florence, 50121 Florence, Italy. [21]IRCCS Fondazione Don Carlo Gnocchi, Florence, Italy. These authors contributed equally: Jonathan M. Schott, Jonathan D. Rohrer, Daniel C. Alexander.

The Genetic FTD Initiative (GENFI)

Christin Andersson[22], Silvana Archetti[23], Andrea Arighi[10], Luisa Benussi[24], Giuliano Binetti[24], Sandra Black[25], Maura Cosseddu[26], Marie Fallström[27], Carlos Ferreira[28], Chiara Fenoglio[9], Morris Freedman[29], Giorgio G Fumagalli[9,10,19], Stefano Gazzina[30], Roberta Ghidoni[24], Marina Grisoli[31], Vesna Jelic[32], Lize Jiskoot[33], Ron Keren[34], Gemma Lombardi[19], Carolina Maruta[35], Lieke Meeter[33], Simon Mead[36], Rick van Minkelen[37], Benedetta Nacmias[19], Linn Öijerstedt[38], Alessandro Padovani[39], Jessica Panman[33], Michela Pievani[24], Cristina Polito[40], Enrico Premi[41], Sara Prioni[31], Rosa Rademakers[42], Veronica Redaelli[31], Ekaterina Rogaeva[43], Giacomina Rossi[31], Martin Rossor[3], Elio Scarpini[9,10], David Tang-Wai[34], Hakan Thonberg[44], Pietro Tiraboschi[34] & Ana Verdelho[45]

[22]Department of Clinical Neuroscience, Karolinska Institutet, 171 77 Solna, Sweden. [23]Biotechnology Laboratory, Department of Diagnostics, Civic Hospital of Brescia, 25123 Brescia, Italy. [24]Istituto di Ricovero e Cura a Carattere Scientifico Istituto Centro San Giovanni di Dio Fatebenefratelli,

Exhibit 14

Journal and conference rankings by category:

1. Top Conferences for Machine Learning & Artificial Intelligence

2. Top Conferences for Biomedical Engineering and Medical Informatics

3. Top Journals for Biomedical & Medical Informatics

4. Top Journals for Computer Science and Electronics

5. Ranking of IPMI: International Conference on Information Processing in Medical Imaging

6. Ranking of the Alzheimer's and Dementia journal

7. Ranking of the NeuroImage journal

Guide2Research

Top Conferences for Machine Learning & Artificial Intelligence

The Top Conferences Ranking for Computer Science & Electronics was prepared by Guide2Research, one of the leading portals for computer science research providing trusted data on scientific contributions since 2014.

The ranking represents h-index, and Impact Score values gathered by November 10th 2020. It was based on a detailed examination of more than 1000 conference profiles and websites.

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1-100 | 101-200 | 201-300 | 301-400 | 401-500 | 501-600 | 601-700 | 701-800 | 801-900 | 901-1000

Rank	Publisher	Conference Details	H5-index	Impact Score
1	IEEE	**CVPR : IEEE/CVF Conference on Computer Vision and Pattern Recognition** Jun 21, 2021 - Jun 24, 2021 - Nashville , **United States** http://cvpr2021.thecvf.com/	299	51.98
2	Neural Information Processing Systems Foundation	**NeurIPS : Neural Information Processing Systems (NIPS)** Dec 6, 2021 - Dec 14, 2021 - Online , **Online** **Deadline : Wed 19 May 2021** https://nips.cc/	198	33.49
3	IEEE	**ICCV : IEEE/CVF International Conference on Computer Vision** Oct 11, 2021 - Oct 17, 2021 - Montreal , **Canada** http://iccv2021.thecvf.com/home	176	32.51
4	Springer	**ECCV : European Conference on Computer Vision** Oct 11, 2021 - Oct 17, 2021 - Montreal , **Canada** http://iccv2021.thecvf.com/	144	25.91
5	aaai	**AAAI : AAAI Conference on Artificial Intelligence** Feb 2, 2021 - Feb 9, 2021 - Vancouver , **Canada** https://aaai.org/Conferences/AAAI-21/	126	25.57
6	PMLR	**ICML : International Conference on Machine Learning (ICML)** Jul 18, 2021 - Jul 24, 2021 - Vienna , **Austria** https://icml.cc/Conferences/2021	171	18.48
10	Association for Computing Machinery	**SIGKDD : ACM SIGKDD International Conference on Knowledge discovery and data mining** Aug 14, 2021 - Aug 18, 2021 - Singapore , **Singapore** https://www.kdd.org/kdd2021/	90	13.53
14	IJCAI	**IJCAI : International Joint Conference on Artificial Intelligence (IJCAI)** Aug 21, 2021 - Aug 26, 2021 - Montreal , **Canada** https://ijcai-21.org/	95	11.71
17	OpenReview	**ICLR : International Conference on Learning Representations** May 4, 2021 - May 8, 2021 - Vienna , **Austria** https://iclr.cc/Conferences/2021/CallForPapers	203	11.38
20		**ACL : Meeting of the Association for Computational Linguistics (ACL)** Aug 1, 2021 - Aug 6, 2021 - Bangkok , **Thailand** https://2021.aclweb.org/	135	10.56
21	Association for Computing Machinery	**WSDM : ACM International Conference on Web Search and Data Mining** Feb 28, 2022 - Mar 4, 2022 - Phoenix , **United States** **Deadline : Mon 09 Aug 2021** http://www.wsdm-conference.org/2022/	54	10.56
22	IEEE	**IROS : IEEE/RSJ International Conference on Intelligent Robots and Systems** Sep 27, 2021 - Oct 1, 2021 - Prague , **Czech Republic** https://www.iros2021.org/	63	10.06
24	Association for Computing Machinery	**SIGMOD : ACM SIGMOD International Conference on Management of Data** Jun 20, 2021 - Jun 25, 2021 - Xi'an , **China** https://2021.sigmod.org/	66	10.06
25	PMLR	**AISTATS : International Conference on Artificial Intelligence and Statistics** Apr 13, 2021 - Apr 15, 2021 - Virtual , **United States** https://aistats.org/aistats2021/	57	9.9
27	Association for Computing Machinery	**CIKM : ACM International Conference on Information and Knowledge Management** Nov 1, 2021 - Nov 5, 2021 - Online , **Online** **Deadline : Wed 19 May 2021** https://www.cikm2021.org/	54	9.4
31		**EMNLP : Conference on Empirical Methods in Natural Language Processing (EMNLP)**	112	9.24

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1-100 | 101-200 | 201-300 | 301-400 | 401-500 | 501-600 | 601-700 | 701-800 | 801-900 | 901-1000

Rank	Publisher	Conference Details	H5-index	Impact Score
26	Springer	**MICCAI : Medical Image Computing and Computer Assisted Intervention** Sep 27, 2021 - Oct 1, 2021 - Strasbourg , **France** https://miccai2021.org/en/	61	9.73
58	IEEE	**ISBI : IEEE International Symposium on Biomedical Imaging** Apr 13, 2021 - Apr 16, 2021 - Iowa , **United States** https://biomedicalimaging.org/2021/	43	6.6
154	ACM	**SAC : ACM Symposium on Applied Computing** Mar 22, 2021 - Mar 26, 2021 - Gwangu , **South Korea** http://www.sigapp.org/sac/sac2021/	30	4.12
164	IEEE	**EMBC : Annual International Conference of the IEEE Engineering in Medicine and Biology Society** Jul 26, 2021 - Jul 30, 2021 - Guadalajara , **Mexico** https://embc.embs.org/2021/	39	3.96
169	IEEE	**Big Data : IEEE International Conference on Big Data** Dec 15, 2021 - Dec 18, 2021 - Orlando , **United States** **Deadline : Tue 31 Aug 2021** http://bigdataieee.org/BigData2021/	41	3.79
198	Springer	**MLMI : International Workshop on Machine Learning in Medical Imaging** Oct 4, 2020 - Oct 8, 2020 - Online , **Online** https://mlmi2020.web.unc.edu/	19	3.46
203	IEEE	**SMC : IEEE International Conference on Systems, Man and Cybernetics** Oct 17, 2021 - Oct 20, 2021 - Melbourne , **Australia** **Deadline : Mon 19 Apr 2021** http://ieeesmc2021.org	29	3.3
217	SPIE	**SPIE Image Processing : Medical Imaging : Image Processing** Feb 14, 2021 - Feb 18, 2021 - San Diego , **United States** https://spie.org/MI/conferencedetails/medical-image-processing?SSO=1	20	3.3
237	IEEE	**BIBM : IEEE International Conference on Bioinformatics and Biomedicine** Dec 9, 2021 - Dec 12, 2021 - Houston , **United States** **Deadline : Sat 28 Aug 2021** https://ieeebibm.org/BIBM2021/	25	3.13
239	Springer	**IPMI : International Conference on Information Processing in Medical Imaging** Jun 27, 2021 - Jul 2, 2021 - Bornholm , **Denmark** https://ipmi2021.org/	23	3.13
241	SPIE	**Medical Imaging : CAD : Medical Imaging : Computer-Aided Diagnosis** Feb 14, 2021 - Feb 18, 2021 - San Diego , **United States** https://spie.org/MI/conferencedetails/computer-aided-diagnosis?SSO=1	22	3.13
271	Springer	**PPSN : International Conference on Parallel problem solving from nature** Sep 5, 2020 - Sep 9, 2020 - Leiden , **Netherlands** https://ppsn2020.liacs.leidenuniv.nl/	16	2.81
280	IEEE	**ICHI : IEEE International Conference on Healthcare Informatics** Aug 9, 2021 - Aug 12, 2021 - Victoria , **Canada** http://ichi2021.institute4hi.org/	21	2.81
295	IEEE	**STACOM : International Workshop on Statistical Atlases and Computational Models of the Heart** Oct 17, 2016 - Oct 17, 2016 - Athens , **Greece** http://stacom2016.cardiacatlas.org/	14	2.81
304	AMIA	**AMIA : AMIA Symposium** Oct 30, 2021 - Nov 3, 2021 - San Diego , **United States** https://www.amia.org/amia2021	26	2.64
317	IEEE	**BHI : IEEE EMBS International Conference on Biomedical & Health Informatics**	18	2.64

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Rank	Publisher	Journal Details	#Top Scientists	#Documents	Impact Score
11	ELSEVIER	Medical Image Analysis ISSN:1361-8415 , Bimonthly	78	149	9.07
36	IEEE	IEEE Transactions on Medical Imaging ISSN:0278-0062 , Monthly	94	179	10.72
57	OXFORD UNIVERSITY PRESS	Bioinformatics ISSN:1367-4803 , Semimonthly	110	203	9.24
69	Springer	Journal of Cheminformatics ISSN:1758-2946 , Irregular	4	4	1.16
74	IEEE	IEEE Journal of Biomedical and Health Informatics ISSN:2168-2194 , Bimonthly	67	98	7.09
81	JMIR Publications	Journal of Medical Internet Research ISSN:1438-8871 , Quarterly	29	36	4.62
96	PLOS	PLoS Computational Biology ISSN:1553-734X ,	58	80	5.61
104	IEEE	IEEE Transactions on Biomedical Engineering ISSN:0018-9294 ,	90	129	8.41
105	WILEY	Human Brain Mapping ISSN:1065-9471 ,	31	53	5.78
112	ELSEVIER	Artificial Intelligence in Medicine ISSN:0933-3657 , Monthly	19	22	3.79
127	IEEE	IEEE Transactions on Biomedical Circuits and Systems ISSN:1932-4545 , Bimonthly	31	53	5.12
132	WILEY	Journal of Magnetic Resonance Imaging ISSN:1053-1807 ,	13	14	3.30
137	OSA	Biomedical Optics Express ISSN:2156-7085 ,	22	30	3.96
147	ELSEVIER	Computerized Medical Imaging and Graphics ISSN:0895-6111 ,	26	29	4.46
161	ELSEVIER	Computer Methods and Programs in Biomedicine ISSN:0169-2607 , Monthly	35	47	5.45
170	ELSEVIER	Journal of Biomedical Informatics ISSN:1532-0464 , Bimonthly	48	69	6.43
189	IEEE	IEEE Transactions on Neural Systems and Rehabilitation Engineering ISSN:1534-4320 ,	41	55	4.79
192	ELSEVIER	Mechanism and Machine Theory ISSN:0094-114X ,	10	15	2.64
195	Springer	Neuroinformatics ISSN:1539-2791 , Quarterly	15	17	2.64

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202	Springer	**BMC Bioinformatics** ISSN:1471-2105 ,	68	107	**4.79**
213	ELSEVIER	**Biomedical Signal Processing and Control** ISSN:1746-8094 ,	17	22	**2.97**
221	Springer	**Journal of Medical Systems** ISSN:0148-5598 , Monthly	20	30	**3.46**
226	ELSEVIER	**International Journal of Medical Informatics** ISSN:1386-5056 , Monthly	12	15	**2.31**
227	ELSEVIER	**Computers and Chemical Engineering** ISSN:0098-1354 , Monthly	11	23	**3.13**
234	IOP Publishing	**Bioinspiration and Biomimetics** ISSN:1748-3182 , Quarterly	13	18	**2.64**
236	SAGE	**Health Informatics Journal** ISSN:1460-4582 , Quarterly	4	4	**1.16**
241	ELSEVIER	**Chemometrics and Intelligent Laboratory Systems** ISSN:0169-7439 , Monthly	4	4	**1.32**
255	SPIE.	**Journal of Biomedical Optics** ISSN:1083-3668 ,	12	15	**2.81**
263	WILEY	**Molecular Informatics** ISSN:1868-1743 , Monthly	2	2	**0.49**
275	Springer	**BioData Mining** ISSN:1756-0381 , Bimonthly	5	15	**1.65**
286	Springer	**Journal of Biomedical Semantics** ISSN: ,	13	13	**2.64**
299	ELSEVIER	**Biocybernetics and Biomedical Engineering** ISSN:0208-5216 ,	5	9	**1.32**
313	Springer	**International Journal of Computer Assisted Radiology and Surgery** ISSN:1861-6410 ,	37	92	**4.12**
334	ELSEVIER	**Journal of Biomechanics** ISSN:0021-9290 ,	16	16	**2.15**
336	Springer	**BMC Medical Informatics and Decision Making** ISSN:1472-6947 , Irregular	23	30	**3.46**
342	SAGE	**Statistical Methods in Medical Research** ISSN:0962-2802 , Bimonthly	7	7	**2.31**
363	Thieme	**Applied Clinical Informatics** ISSN: , Quarterly	9	12	**1.81**
376	WILEY	**International Journal for Numerical Methods in Biomedical Engineering** ISSN:2040-7939 , Monthly	9	8	**1.49**
381	Springer	**BioMedical Engineering Online** ISSN:1475-925X ,	8	8	**1.16**
383	ELSEVIER	**Magnetic Resonance Imaging** ISSN:0730-725X ,	8	10	**1.32**
390	WILEY	**International Journal of Medical Robotics and Computer Assisted Surgery** ISSN:1478-5951 ,	14	16	**2.81**
405	IEEE	**IEEE/ACM Transactions on Computational Biology and Bioinformatics** ISSN:1545-5963 , Bimonthly	59	99	**3.30**
410	Springer	**Medical and Biological Engineering and Computing** ISSN:0140-0118 , Monthly	16	21	**2.97**

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411	International Journal of Bio-Inspired Computation ISSN:1758-0366 , Bimonthly	7	8	1.65
417	IETE Technical Review ISSN:0256-4602 , Bimonthly	2	3	0.66
487	Methods of Information in Medicine ISSN:0026-1270 , Bimonthly	6	13	1.49
508	Computer Methods in Biomechanics and Biomedical Engineering ISSN:1025-5842 , Semimonthly	6	7	0.99
527	Algorithms for Molecular Biology ISSN:1748-7188 ,	7	6	1.49
541	Informatics for Health and Social Care ISSN:1753-8157 , Quarterly	2	2	0.49
612	Journal of Computational Biology ISSN:1066-5277 , Monthly	22	26	2.31
660	Technology and Health Care ISSN:0928-7329 ,	3	4	0.82
668	International Journal of Data Mining and Bioinformatics ISSN:1748-5673 , Monthly	6	6	0.82
734	Journal of Medical Imaging ISSN:2329-4302 ,	23	36	3.79
734	Computer Methods in Biomechanics and Biomedical Engineering: Imaging and Visualization ISSN:2168-1163 ,	17	16	3.30
734	Healthcare Technology Letters ISSN: ,	10	15	2.15
734	Smart Health ISSN: ,	8	10	1.32
734	Brain-Computer Interfaces ISSN:2326-263X ,	7	8	1.16
734	Digital Health ISSN:2055-2076 ,	5	6	0.99
734	Brain Informatics ISSN:2198-4018 ,	4	4	0.99
734	JCO Clinical Cancer Informatics ISSN:2473-4276 ,	3	3	0.99
734	IEEE Transactions on Medical Robotics and Bionics ISSN: ,	7	6	0.82
734	Informatics in Medicine Unlocked ISSN: ,	3	4	0.66
734	BMJ Health and Care Informatics ISSN: ,	2	2	0.33
734	EAI Endorsed Transactions on Pervasive Health and Technology ISSN:2411-7145 ,	2	2	0.33
734	Bio-Algorithms and Med-Systems ISSN:1895-9091 ,	1	2	0.33
734	International Journal of E-Health and Medical Communications ISSN:1947-315X ,	1	1	0.33
734	International Journal of Healthcare Information Systems and Informatics ISSN:1555-3396 ,	1	1	0.17

Rank	Publisher	Journal Details	#Top Scientists	#Documents	Impact Score

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Rank	Publisher	Journal Details	#Top Scientists	#Documents	Impact Score
1	IEEE	IEEE Communications Surveys and Tutorials ISSN:1553-877X , Quarterly	110	155	20.30
2	AAAS	Science Robotics ISSN: ,	31	34	6.11
3	IEEE	IEEE Transactions on Pattern Analysis and Machine Intelligence ISSN:0162-8828 , Monthly	284	461	25.25
4	ELSEVIER	Information Fusion ISSN:1566-2535 , Quarterly	67	100	10.89
5	IEEE	IEEE Industrial Electronics Magazine ISSN:1932-4529 , Quarterly	9	8	2.64
6	IEEE	IEEE Geoscience and Remote Sensing Magazine ISSN:2168-6831 ,	8	18	2.48
7	IEEE	IEEE Journal on Selected Areas in Communications ISSN:0733-8716 , Monthly	201	326	19.80
8	IEEE	IEEE Wireless Communications ISSN:1536-1284 , Bimonthly	95	192	14.36
9	IEEE	IEEE Signal Processing Magazine ISSN:1053-5888 , Bimonthly	115	157	13.86
10	IEEE	IEEE Transactions on Evolutionary Computation ISSN:1089-778X , Bimonthly	40	97	8.09
11	ELSEVIER	Medical Image Analysis ISSN:1361-8415 , Bimonthly	78	149	9.07
12	IEEE	IEEE Transactions on Cybernetics ISSN:2168-2267 , Monthly	184	541	15.84
13	IEEE	IEEE Communications Magazine ISSN:0163-6804 , Monthly	178	366	22.11
14	WILEY	International Journal of Intelligent Systems ISSN:0884-8173 , Monthly	28	51	4.12
15	IEEE	Proceedings of the IEEE ISSN:0018-9219 , Monthly	139	133	13.04
16	IEEE	IEEE Internet of Things Journal ISSN:2327-4662 , Quarterly	252	604	17.66
17	IEEE	IEEE Transactions on Fuzzy Systems ISSN:1063-6706 , Bimonthly	77	245	10.39
18	IEEE	IEEE Transactions on Image Processing ISSN:1057-7149 , Monthly	259	629	20.13
19	IEEE	IEEE Transactions on Industrial Informatics	175	328	15.51

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IPMI 2021 : International Conference on Information Processing in Medical Imaging

Posted on October 30, 2020 in Conferences

Conference Information

Submission Deadline	Tuesday 01 Dec 2020
Conference Dates	Jun 27, 2021 - Jul 2, 2021
Conference Address	Bornholm, Denmark
Conference & Submission Link	https://ipmi2021.org/

Proceedings indexed by : Springer

Conference Organizers : (*Deadline extended ? Click here to edit*)

Conference Ranking & Metrics (This is a TOP Conference)

Impact Score	3.13	Guide2Research Overall Ranking:	239
#Contributing Top Scientists	35	*Category Rankings*	
		Biomedical & Medical Informatics	10
#Papers published by Top Scientists	49	*Image Processing & Computer Vision*	34
Google Scholar H5-index	23		
Proceedings	https://link.springer.com/conference/ipmi		

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IPMI's mission is to facilitate and showcase the latest methodological developments within medical imaging. An "IPMI paper" presents novel methodological developments that solve medical imaging analysis problems. Today, IPMI is widely recognised as a preeminent international forum for presentation of cutting edge research in the medical imaging field including the topics below.

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Computational anatomy and physiology
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Functional and molecular imaging
Imaging and genomics
Image guided surgery
Uncertainty estimation
Interpretability and explainable algorithms
Loss functions for medical imaging
Transfer learning, domain adaptation, data harmonization
Generative modelling
Learning with noisy or limited data
Statistical and mathematical models
Geometric learning, geometric deep learning, geometric statistics
Shape modeling and analysis

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IEEE	CoG 2021 : IEEE Conference on Games Aug 17, 2021 - Aug 20, 2021 - Copenhagen	Denmark	*Deadline :* Fri 09 Apr 2021
acm Association for Computing Machinery	VMCAI 2021 : Verification, Model Checking and Abstract Interpretation Jan 17, 2021 - Jan 22, 2021 - Copenhagen	Denmark	*Deadline :* Mon 11 Oct 2021

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Alzheimer's and Dementia - Impact Factor, Overall Ranking, h-index, SJR, Rating, Publisher, ISSN, and other Important Metrics

Impact Factor	H-Index	Rank	SJR
11.99	94	258	5.45

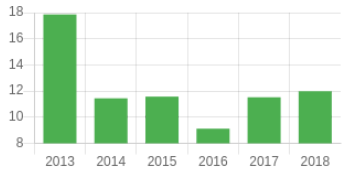
Note: The **impact factor** shown here is equivalent to **citescore** and is, therefore, used as a replacement for the same. Citescore is produced by Scopus, and can be a little higher or different compared to the impact factor produced by Journal Citation Report. Please refer to Web of Science data source for checking the exact journal impact factor ™ (Thomson Reuters) metric.

Title	**Alzheimer's and Dementia**
Publication Type	**journal**
Subject Area, Categories, Scope	**Cellular and Molecular Neuroscience (Q1); Developmental Neuroscience (Q1); Epidemiology (Q1); Geriatrics and Gerontology (Q1); Health Policy (Q1); Neurology (clinical) (Q1); Psychiatry and Mental Health (Q1)**
h-index	**94**
Overall Rank/Ranking	**258**
SCImago Journal Rank (SJR)	**5.45**
Impact Factor	**11.99**
Publisher	**Elsevier BV**
Country	**Netherlands**
ISSN	**15525279, 15525260**

About Alzheimer's and Dementia

Alzheimer's and Dementia is a **journal** covering the technologies/fields/categories related to **Cellular and Molecular Neuroscience (Q1); Developmental Neuroscience (Q1); Epidemiology (Q1); Geriatrics and Gerontology (Q1); Health Policy (Q1); Neurology (clinical) (Q1); Psychiatry and Mental Health (Q1)**. It is published by **Elsevier BV**. The overall rank of Alzheimer's and Dementia is **258**. According to **SCImago Journal Rank (SJR)**, this journal is ranked **5.45**. SCImago Journal Rank is an indicator, which measures the scientific influence of journals. It considers the number of citations received by a journal and the importance of the journals from where these citations come. SJR acts as an alternative to the Journal Impact Factor (or an average number of citations received in last 2 years). This journal has an **h-index** of **94**. The **best quartile** for this **journal** is **Q1**.

Year wise Impact Factor (IF) of Alzheimer's and Dementia



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Acta Neuropathologica
Springer Verlag | Germany

Nature Reviews Neurology
Nature Publishing Group | United Kingdom

Molecular Psychiatry
Nature Publishing Group | United Kingdom

Molecular Neurodegeneration
BioMed Central | United Kingdom

Cerebral Cortex
Oxford University Press | United Kingdom

Neurobiology of Stress
Elsevier BV | Netherlands

Acta Neuropathologica Communications
BioMed Central | United Kingdom

Cellular and Molecular Life Sciences
Birkhauser Verlag | Switzerland

PLoS Computational Biology
Public Library of Science | United States

GLIA
John Wiley & Sons Inc. | United States

Top Journals/Conferences in Developmental Neuroscience

Journal of Experimental Psychology: General
American Psychological Association | United States

Molecular Autism
BioMed Central | United Kingdom

Frontiers in Systems Neuroscience
Frontiers Media S.A. | Switzerland

Experimental Neurology
Elsevier Inc. | United States

Neural Development
BioMed Central | United Kingdom

NeuroImage - Impact Factor, Overall Ranking, h-index, SJR, Rating, Publisher, ISSN, and other Important Metrics

Impact Factor	H-Index	Rank	SJR
5.88	320	540	3.354

Note: The **impact factor** shown here is equivalent to **citescore** and is, therefore, used as a replacement for the same. Citescore is produced by Scopus, and can be a little higher or different compared to the impact factor produced by Journal Citation Report. Please refer to Web of Science data source for checking the exact journal impact factor ™ (Thomson Reuters) metric.

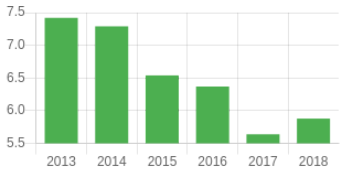
Title	**NeuroImage**
Publication Type	**journal**
Subject Area, Categories, Scope	**Cognitive Neuroscience (Q1); Neurology (Q1)**
h-index	**320**
Overall Rank/Ranking	**540**
SCImago Journal Rank (SJR)	**3.354**
Impact Factor	**5.88**
Publisher	**Elsevier Inc.**
Country	**United States**
ISSN	**10959572, 10538119**

About NeuroImage

NeuroImage is a **journal** covering the technologies/fields/categories related to **Cognitive Neuroscience (Q1); Neurology (Q1)**. It is published by **Elsevier Inc.**. The overall rank of NeuroImage is **540**. According to **SCImago Journal Rank (SJR)**, this journal is ranked **3.354**. SCImago Journal Rank is an indicator, which measures the scientific influence of journals. It considers the number of citations received by a journal and the importance of the journals from where these citations come. SJR acts as an alternative to the Journal Impact Factor (or an average number of citations received in last 2 years). This journal has an **h-index** of **320**. The **best quartile** for this **journal** is **Q1**.

The ISSN of **NeuroImage** journal is **10959572, 10538119**. An International Standard Serial Number (ISSN) is a unique code of 8 digits. It is used for the recognition of journals, newspapers, periodicals, and magazines in all kind of forms, be it print-media or electronic. **NeuroImage** is cited by a total of **15610** articles during the last 3 years (Preceding 2018).

Year wise Impact Factor (IF) of NeuroImage



Click here to check table

Top Journals/Conferences in Cognitive Neuroscience

Trends in Cognitive Sciences
Elsevier BV | Netherlands

Neuroscience and Biobehavioral Reviews
Elsevier Ltd. | United Kingdom

Cerebral Cortex
Oxford University Press | United Kingdom

Developmental Science
Blackwell Publishing Inc. | United Kingdom

Cognition
Elsevier BV | Netherlands

Developmental Cognitive Neuroscience
Elsevier BV | Netherlands

Alzheimer's Research and Therapy
BioMed Central | United Kingdom

Hippocampus
John Wiley & Sons Inc. | United States

Cortex
Masson Publishing | France

Translational Neurodegeneration
BioMed Central | United Kingdom

Top Journals/Conferences in Neurology

The Lancet Neurology
The Lancet Publishing Group | United Kingdom

Acta Neuropathologica
Springer Verlag | Germany

Nature Reviews Neurology
Nature Publishing Group | United Kingdom

Brain
Oxford University Press | United Kingdom

Annals of Neurology
John Wiley & Sons Inc. | United States

Alzheimer's and Dementia

Exhibit 15

Proof of 30 scientific reviews undertaken by Dr. Marinescu in conferences and journals on artificial intelligence, computer vision and medical imaging.

- 1 review for CVPR: International Conference on Computer Vision and Pattern Reconigiton
- 3 reviews for NeurIPS: The Conference on Neural Information Processing Systems
- 6 reviews for ICML: International Conference on Machine Learning
- 6 reviews for MICCAI: Medical Image Computing and Computer Assisted Interventions
- 8 reviews for IPMI: International Conference on Information Processing in Medical Imaging
- 1 review for NeuroImage (journal)
- 1 review for Nature Communications (journal)
- 1 review for MedIA (journal): Medical Image Analysis
- 1 review for PAMI (journal): IEEE Transactions on Pattern Analysis and Machine Intelligence
- 2 reviews for JAD (journal): Journal of Alzheimer's Disease Research

Exhibit 16

Proof that Dr. Marinescu was on the hiring committee of the MIT ICEO

Exhibit 17

Nadri, Hamed, et al. ,"The top 100 articles in the medical informatics: a bibliometric analysis." Journal of medical systems

J Med Syst (2017) 41: 150
DOI 10.1007/s10916-017-0794-4

EDUCATION & TRAINING

The Top 100 Articles in the Medical Informatics: a Bibliometric Analysis

Hamed Nadri[1,2] · **Bahlol Rahimi**[1] · **Toomas Timpka**[3,4] · **Shahram Sedghi**[5]

Received: 1 April 2017 / Accepted: 30 July 2017 / Published online: 19 August 2017

Abstract The number of citations that a research paper receives can be used as a measure of its scientific impact. The objective of this study was to identify and to examine the characteristics of top 100 cited articles in the field of Medical Informatics based on data acquired from the Thomson Reuters' Web of Science (WOS) in October, 2016. The data was collected using two procedures: first we included articles published in the 24 journals listed in the "Medical Informatics" category; second, we retrieved articles using the key words: "informatics", "medical informatics", "biomedical informatics", "clinical informatics" and "health informatics". After removing duplicate records, articles were ranked by the number of citations they received. When the 100 top cited articles had been identified, we collected the following information for each record: all WOS database citations, year of publication, journal, author names, authors' affiliation, country of origin and topics indexed for each record. Citations for the top 100 articles ranged from 346 to 7875, and citations per year ranged from 11.12 to 525. The majority of articles were published in the 2000s (n=43) and 1990s (n=38). Articles were published across 10 journals, most commonly Statistics in medicine (n=71) and Medical decision making (n=28). The articles had an average of 2.47 authors. Statistics and biostatistics modeling was the most common topic (n=71), followed by artificial intelligence (n=12), and medical errors (n=3), other topics included data mining, diagnosis, bioinformatics, information retrieval, and medical imaging. Our bibliometric analysis illustrated a historical perspective on the progress of scientific research on Medical Informatics. Moreover, the findings of the current study provide an insight on the frequency of citations for top cited articles published in Medical Informatics as well as quality of the works, journals, and the trends steering Medical Informatics.

Keywords Medical informatics · Articles · Bibliometric · Top-cited

This article is part of the Topical Collection on *Education & Training*

Electronic supplementary material The online version of this article (doi:10.1007/s10916-017-0794-4) contains supplementary material, which is available to authorized users.

✉ Bahlol Rahimi
bahlol.rahimi@gmail.com

[1] Department of Health Information Technology, Urmia University of Medical Sciences, Urmia, Iran

[2] Student Research Committee, Urmia University of Medical Sciences, Urmia, Iran

[3] Department of computer and information Sciences, Linköping University, Linköping, Sweden

[4] Department of Medical and Health Sciences, Linköping University, Linköping, Sweden

[5] Department of Librarianship and Medical Information Science, Iran University of Medical Sciences, Tehran, Iran

Introduction

The first professional organization for practitioners working with medical information management was founded by Gustav Wagner in Germany back in 1949; while, the first appearance of the specific term Medical Informatics as a denotation of a research and practice area occurred in France in 1960s. Specialized academic departments and courses for Medical Informatics were established in European countries (1960s) and in the United States (1970s). In 2016, the International Medical Informatics Association (IMIA) had more than 40 national association members. To quantify the

impact from research in a sub-area of medicine such as Medical Informatics, the number of citations that a publication receives can be used as an objective indicator. Citation analysis is an approach that uses citation data, productivity, and evaluation based on the number of references that an article receives over the time [1, 2]. The pertinence of published article to a specific area is echoed in the amount of citations from peers it obtains. Citation analysis examines a network of published articles to assess an individual article's impact on its field [3]. Analysis of the most frequently cited articles is used to identify research trends within specific topics and to pinpoint the most frequently occurring authors, journals, and institutions [4]. The number of citations is hugely important for journals since the Impact Factor (IF) of a journal is reliant on the number of citations it receives [5–8], Nevertheless, this indicates the demands for certain articles brought out by researchers and the influence of the articles in generating changes in practice, controversies, discussions, or further researches. The number of citations is considered as a direct measure of the recognition that an article warranted in its field [9–11]. As the journal IF, it can be used as a proxy for scientific quality and originality [12]. The Institute for Scientific Information (ISI) has collected the citations data since 1945 and publicized these data electronically since 1979. Recently, ISI introduced the newest journal citation system called ": Science Citation Index® (SCI) Expanded," and it is one of the databases available in the Web of Science portal. Using the citation data retrieved from Web of Sciences databases, researchers have identified and analyzed highly cited articles in different areas of medicine such as Radiology [13, 14], Orthopedic [15], Pathology [16], Neurosurgery [17], Urology [18, 19], Emergency [20], and Dermatology [21].

In Medical Informatics, bibliometric studies have previously been used to characterize subdomains such as, modeling [22], computer-based medical records [23], as categorized and indexed in Medical Subject Headings of national Library of medicine(referred to as "MESH" terms) [24]. Andrews used a co-citation analyses method to visualize scholarly communication in the field, as well as identify the most productive and prominent authors [25, 26]. Studies have also used citation analysis to develop a core set of Medical Informatics serials [27, 28]. A study by Morris and colleagues found that Medical Informatics is a maturing interdisciplinary field when it identified a relatively small core literature [27]. However, to the best of our knowledge, there was not a comprehensive study focusing on top-cited articles in the field of Medical Informatics.

The aim of this study was to identify the 100 top-cited articles published in Medical Informatics and to examine their main characteristics to gain insight into the types of publications influential attributes in this field. The purpose is to expand the understanding of the role that Medical Informatics plays in medical research and practice.

Materials and methods

We performed a bibliometric analysis of the most highly cited original research articles (excluding Reviews, Proceeding Papers, Editorial Material, etc.) in Medical Informatics using data obtained from the WOS database in October 2016. No time limitations were implemented on the investigation. It is widely known that the citation counts from resources such as Google Scholar, Scopus, and WOS vary [2, 13, 29]. We chose the WOS since we found that it was the database providing the highest scientific quality. It also was compliant with our methods relying on search terms [13], the ability to classify articles to the "Medical Informatics" category as well as WOS has been shown to be the most robust scientific database resource for medicine [2]. The meaning of "Medical Informatics" term for this study was defined as "informatics applied to medical knowledge, practice, management, report, education, and research"[30]; Informatics was here used to denote the study of information and ways to process and handle it. We applied two procedures to identify research articles in the field of medical informatics. These were:

i) Articles published in the 24 journals listed under the Web of Knowledge subject category of "medical informatics", to include all the papers in the field of Medical Informatics.
ii) Articles indexed using following keywords: "informatics", "medical informatics", "biomedical informatics"," clinical informatics" and "health informatics" were identified by searching the WOS database.

Because of the multidisciplinary nature of the Medical Informatics field, it can be difficult to determine whether a scientific article belongs to the field per se. We therefore collected all articles classified using the subject category "Medical Informatics" in WOS, and articles that evidently were published in another primary field was excluded from the study.

All articles retrieved in both procedures were imported into a Microsoft Excel 2010 worksheet. Then we removed the duplicate papers from the list. The articles were sorted according to their citation number and listed in descending order. It was assumed that the least cited article in the list would have 100 or more citations. Articles with less than 100 citations were therefore excluded.

Each article was examined regarding following attributes: publication date, journal name, first and senior authors, year of publication, geographic origin, total number of citations, and citation density (total citations/article age). Continuous variables were summarized with descriptive statistics such as range, mean, and median. Categorical variables were

Table 1 Journals in which the 100 top-cited articles in the Medical Informatics were published

Rank	Journal	Frequency (n)	Impact factor
1	STATISTICS IN MEDICINE	71	1.533
2	MEDICAL DECISION MAKING	10	2.908
3	JOURNAL OF THE AMERICAN MEDICAL INFORMATICS ASSOCIATION	6	2.363
4	COMPUTER METHODS AND PROGRAMS IN BIOMEDICINE	4	1.862
5	JOURNAL OF BIOMEDICAL INFORMATICS	3	2.447
6	MEDICAL & BIOLOGICAL ENGINEERING & COMPUTING	2	1.797
7	IEEE TRANSACTIONS ON INFORMATION TECHNOLOGY IN BIOMEDICINE	1	2.493
8	JOURNAL OF MEDICAL INTERNET RESEARCH	1	4.532
9	METHODS OF INFORMATION IN MEDICINE	1	2.248
10	STATISTICAL METHODS IN MEDICAL RESEARCH	1	4.634

expressed as frequency and percentage. Finally the data were analyzed using HistCite[1] and SPSS 20.[2]

Results

Sources and citations

The 100 most cited articles were published in 10 journals (Table 1). The articles in the list had been cited between 346 and 7875 times (Table 2). The citation density for the articles ranged from 11.12 to 525 citations/year; mean 47.65 citations/year and median 31.26 citations/year. The top three articles based on citation density were "*Quantifying heterogeneity in a meta-analysis*" (525 citations/year), "*Research electronic data capture (REDCap)-A metadata-driven methodology and workflow process for providing translational research informatics support*" [31] (305.25 citations/year), and "*Evaluating the added predictive ability of a new marker: From area under the ROC curve to reclassification and beyond*" (78.33 citations/year). The years 1998 and 2004 were the years with the greatest number of top-cited articles (n = 8), followed by 2002 (n = 7), 2000 and 1999 (n = 6). That articles related to year 2002 had more Global Citation Score (shows the total number of citations to a paper) with (GCS = 11,104). In addition, 4 top-cited articles per year were published in 2002, 1984, 1998, and 1993.

The impact factors for journals with the top 100 cited articles ranged from 1.5 to 4.6. The higher immediacy index also belonged to the journal with the lowest impact factor. Specialized Medical Informatics journal such as the JAMIA, only had 6 articles to the list despite its high impact factor.

[1] HistCite™ Inc. Released 2008. Garfield, E: Thomson Reuters.
[2] SPSS Inc. Released 2007. SPSS for Windows, Version 20.0. Chicago, SPSS Inc.

Author affiliations and numbers

The country of origin, number of manuscripts per institution and type of manuscript are described in Table 2. The two most common departmental affiliations of first authors were Statistics and Biostatics (n = 71) and Artificial Intelligence/Medical Decision Analysis (n = 12). Other affiliations of first authors included Cancer Research, Nursing, Public Health, Engineering, Bioinformatics and Nutrition Research. The

Table 2 Descriptors of the 100 top-cited manuscripts in the Medical Informatics including country of origin, number of manuscripts per institution and type of manuscript

	Descriptor	Frequency (percentage)
Country of origin (n = 100)	USA	52 (52%)
	UK	25 (25%)
	Canada	11 (11%)
	Australia	4 (4%)
	Netherlands	5 (5%)
	Finland	2 (2%)
	Germany	2 (2%)
	Italy	2 (2%)
	Sweden	2 (2%)
	Other: Austria, Israel, Switzerland and Thailand	1 each (1% each)
Number of Institutions (n = 103)	1	12 (12%)
	2	5 (5%)
	3	5 (5%)
	4	5 (5%)
	5–15	36 (36%)
	>15	40 (40%)
Type of manuscript (n = 100)	Original journal article	92 (92%)
	Conference proceedings paper	8 (8%)

average number of authors for the 100 most cited works was 2.47 authors per paper. The number of authors per paper ranged from 1 to 10, and 96% were co-written by six authors or fewer. Individual authors contributed anywhere from 1 to 20 articles on the list. Twenty-two authors contributed more than one article to the top 100 list.

Year of publication

The articles included in this study were published between 1983 and 2011. The average number of years since publication was 29 years and most of the articles were published in the 2000s. Figure 1 is a graphical representation of the distribution of the 100 top cited articles by decade of publication (Table 3).

Discussion

Given the multidisciplinary nature of Medical Informatics, we used the WOS subject category 'Medical Informatics' to retrieve articles. This had as consequence that for some well-known articles in the core field of Medical Informatics and bioinformatics, the number of citations was not sufficient to enter the Top 100 list. We noted that the 1st and 2nd articles in the list with the highest number of citations were published in the biostatistics sub-area. "Statistics in Medicine" was also the Medical Informatics journal that accumulated the most publications (71 articles). However, the "Medical Decision Making" journal was the second with 28 articles and the "Journal of the American Medical Informatics Association" was the third with 6 articles. "Computer Methods and Programs in Biomedicine" was the 4th journal in rank and there was no other journal contributing more than three articles to the list. It is our understanding that the high number of articles belonging to the biostatistics sub-area in the top 100 list is due to that these papers to a high degree also was cited by authors from other medical disciplines than Medical Informatics. Correspondingly, further investigations revealed that 71 of the articles had statistics and biostatics as the subject area, while medical artificial intelligence/decision analysis was the focus of 12 articles. Journals specialized in the core topics of Medical Informatics contributed only a small portion of 100 top cited articles in comparison to non-specialized journals addressing a larger community of medical researchers and practitioners.

Our bibliometric analysis shows that the most cited article in Medical Informatics is the 2002 paper by Higgins JPT and et al., "Quantifying heterogeneity in a meta-analysis," in *Statistics in Medicine*. In addition, this was the article with the most citations per year since publication. Citations per year is a metric which allows us to evaluate which articles are presently being the most widely read and cited, effectively correcting the total citations for time since publication. Figure 2 is a graphical representation of the distribution of the 100 top cited articles by Citations per year. 61 of the 100 most cited articles were published before 2000, biasing the list in favor of articles that have had longer periods of time since publication to accumulate citations. Regarding research institutions, the largest number of records (12 articles) originated from Harvard University, followed by Boston University, and Toronto University with 5 articles each. The number of institutional subdivisions was 149, with Harvard University Medicine School contributing 8 articles, Harvard University School of Public Health 6 articles, and Cambridge Institute of Public Health/MRC Biostatistics Unit (BSU) 4 articles.

We also demonstrate that the majority (n = 43) of the most highly cited articles were published in 2000s. This is contrary to the most of the other bibliometric analyses, which generally have reported that the peak period for citations was between 1980 and 1995 [32–34]. However, elapsed time is required for the articles to accrue citations and gain significant coverage. This lack of elapsed time can explain the relatively few top cited articles published during 2000–2016. The distribution of citations in Fig. 2 with a significant number of citations over the last few years demonstrate the dynamics of the Medical

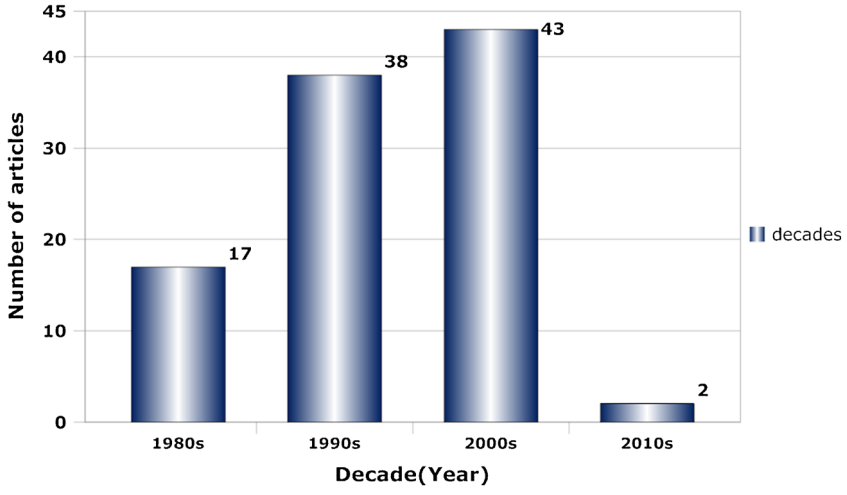


Fig. 1 Distribution of the 100 top-cited articles in the Medical Informatics by decade of publication

Table 3 The 100 top-cited articles in Medical Informatics ranked in descending order of number of citations

Rank	Article	Citations	Citation per year	Rank by citation per year
1	Higgins, Julian, and Simon G. Thompson. "Quantifying heterogeneity in a meta-analysis." Statistics in medicine 21.11 (2002)	7875	525	1
2	Harrell, Frank E., et al. "Regression modelling strategies for improved prognostic prediction." Statistics in medicine 3.2 (1984)	3462	164.86	5
3	d'Agostino, Ralph B. "Tutorial in biostatistics: propensity score methods for bias reduction in the comparison of a treatment to a non-randomized control group." Statistics in medicine 17.19 (1998)	2515	132.37	4
4	Pencina, Michael J., and Ralph B. D'Agostino. "Overall C as a measure of discrimination in survival analysis: model specific population value and confidence interval estimation." Statistics in medicine 23.13 (2004)	2505	278.33	2
5	Harris, Paul A., et al. "Research electronic data capture (REDCap)—a metadata-driven methodology and workflow process for providing translational research informatics support." Journal of biomedical informatics 42.2 (2009)	2442	305.25	18
6	Wang, Lihong, Steven L. Jacques, and Liqiong Zheng. "MCML—Monte Carlo modeling of light transport in multi-layered tissues." Computer methods and programs in biomedicine 47.2 (1995)	1750	79.55	3
7	Parmar, Mahesh KB, Valter Torri, and Lesley Stewart. "Extracting summary statistics to perform meta-analyses of the published literature for survival endpoints." Statistics in medicine 17.24 (1998)	1707	89.84	34
8	Newcombe, Robert G. "Interval estimation for the difference between independent proportions: comparison of eleven methods." Statistics in medicine 17.8 (1998)	1676	88.21	7
9	Gooley, Ted A., et al. "Estimation of failure probabilities in the presence of competing risks: new representations of old estimators." Statistics in medicine 18.6 (1999)	1433	79.61	8
10	Sonnenberg, Frank A., and J. Robert Beck. "Markov models in medical decision making a practical guide." Medical decision making 13.4 (1993)	1231	51.29	29
11	Kim, Hyune-Ju, et al. "Permutation tests for joinpoint regression with applications to cancer rates." Statistics in medicine 19.3 (2000)	1165	68.53	9
12	Hochberg, Yosef, and Yoav Benjamini. "More powerful procedures for multiple significance testing." Statistics in medicine 9.7 (1990)	1081	40.04	6
13	Cole, Timothy J., and Pamela J. Green. "Smoothing reference centile curves: the LMS method and penalized likelihood." Statistics in medicine 11.10 (1992)	1068	42.72	11
14	Prentice, Ross L. "Surrogate endpoints in clinical trials: definition and operational criteria." Statistics in medicine 8.4 (1989)	998	35.64	15
15	Thompson, Simon G., and Julian Higgins. "How should meta-regression analyses be undertaken and interpreted?." Statistics in medicine 21.11 (2002)	972	64.8	42
16	Van Buuren, Stef, Hendriek C. Boshuizen, and Dick L. Knook. "Multiple imputation of missing blood pressure covariates in survival analysis." Statistics in medicine 18.6 (1999)	902	50.11	32
17	Durrleman, Sylvain, and Richard Simon. "Flexible regression models with cubic splines." Statistics in medicine 8.5 (1989)	891	31.82	35
18	White, Ian R., Patrick Royston, and Angela M. Wood. "Multiple imputation using chained equations: issues and guidance for practice." Statistics in medicine 30.4 (2011)	838	139.67	10
19	Cuzick, Jack. "A wilcoxon-type test for trend." Statistics in medicine 4.4 (1985)	834	26.06	45
20	Moses, Lincoln E., David Shapiro, and Benjamin Littenberg. "Combining independent studies of a	807	33.62	16

Table 3 (continued)

Rank	Article	Citations	Citation per year	Rank by citation per year
	diagnostic test into a summary ROC curve: data-analytic approaches and some additional considerations." Statistics in medicine 12.14 (1993)			
21	Thompson, Simon G., and Stephen J. Sharp. "Explaining heterogeneity in meta-analysis: a comparison of methods." Statistics in medicine 18.20 (1999)	764	42.44	84
22	Newcombe, Robert G. "Two-sided confidence intervals for the single proportion: comparison of seven methods." Statistics in medicine 17.8 (1998)	738	38.84	31
23	Altman, Douglas G., and Patrick Royston. "What do we mean by validating a prognostic model?." Statistics in medicine 19.4 (2000)	724	42.59	33
24	O'Connor, Annette M. "Validation of a decisional conflict scale." Medical decision making 15.1 (1995)	697	31.68	27
25	Harrell, Frank E., Kerry L. Lee, and Daniel B. Mark. "Tutorial in biostatistics multivariable prognostic models: issues in developing models, evaluating assumptions and adequacy, and measuring and reducing errors." Statistics in medicine 15 (1996)	696	21.09	13
26	Hosmer DW, Hosmer T, leCessie S, Lemeshow S. "A comparison of goodness-of-fit tests for the logistic regression model." Statistic in medicine. 16.9 (1997).	694	34.7	23
27	Van Houwelingen, Hans C., Lidia R. Arends, and Theo Stijnen. "Advanced methods in meta-analysis: multivariate approach and meta-regression." Statistics in medicine 21.4 (2002)	688	45.87	21
28	Hämäläinen, Matti S., and Risto J. Ilmoniemi. "Interpreting magnetic fields of the brain: minimum norm estimates." Medical and biological engineering and computing 32.1 (1994)	666	28.96	88
29	Lunn, David, et al. "The BUGS project: Evolution, critique and future directions." Statistics in medicine 28.25 (2009)	662	82.75	56
30	Ash, Joan S., Marc Berg, and Enrico Coiera. "Some unintended consequences of information technology in health care: the nature of patient care information system-related errors." Journal of the American Medical Informatics Association 11.2 (2004)	627	36	48
31	Royston, Patrick, Douglas G. Altman, and Willi Sauerbrei. "Dichotomizing continuous predictors in multiple regression: a bad idea." Statistics in medicine 25.1 (2006)	622	48.23	77
32	Lu, Guobing, and A. E. Ades. "Combination of direct and indirect evidence in mixed treatment comparisons." Statistics in medicine 23.20 (2004)	619	56.55	12
33	Dweep, Harsh, et al. "miRWalk–database: prediction of possible miRNA binding sites by "walking" the genes of three genomes." Journal of biomedical informatics 44.5 (2011)	613	47.62	71
34	Harbord, Roger M., Matthias Egger, and Jonathan AC Sterne. "A modified test for small-study effects in meta-analyses of controlled trials with binary endpoints." Statistics in medicine 25.20 (2006)	610	102.17	55
35	Fryback, Dennis G., and John R. Thornbury. "The efficacy of diagnostic imaging." Medical decision making 11.2 (1991)	604	55.45	22
36	Walter, S. D., M. Eliasziw, and A. Donner. "Sample size and optimal designs for reliability studies." Statistics in medicine 17.1 (1998)	599	31.53	39
37	Kulldorff, Martin, and Neville Nagarwalla. "Spatial disease clusters: detection and inference." Statistics in medicine 14.8 (1995)	599	23.23	78
38	Van Essen, David C., et al. "An integrated software suite for surface-based analyses of cerebral cortex." Journal of the American Medical Informatics Association 8.5 (2001)	595	27.23	95
39	Cole, Tim J., Jenny V. Freeman, and Michael A. Preece. "British 1990 growth reference centiles for weight,	589	37.19	30

Table 3 (continued)

Rank	Article	Citations	Citation per year	Rank by citation per year
	height, body mass index and head circumference fitted by maximum penalized likelihood." Statistics in medicine 17.4 (1998)			
40	Metz, Charles E., Benjamin A. Herman, and Jong-Her Shen. "Maximum likelihood estimation of receiver operating characteristic (ROC) curves from continuously-distributed data." Statistics in medicine 17.9 (1998)	588	31	14
41	Fryback, Dennis G., et al. "The Beaver Dam Health Outcomes Study: initial catalog of health-state quality factors." Medical Decision Making 13.2 (1993)	576	30.95	26
42	Putter, Hein, M. Fiocco, and R. B. Geskus. "Tutorial in biostatistics: competing risks and multi-state models." Statistics in medicine 26.11 (2007)	570	57	20
43	Rubin, Donald B., and Nathaniel Schenker. "Multiple imputation in health-are databases: An overview and some applications." Statistics in medicine 10.4 (1991)	570	24	62
44	Jiang, Hangyi, et al. "DtiStudio: resource program for diffusion tensor computation and fiber bundle tracking." Computer methods and programs in biomedicine 81.2 (2006)	560	21.92	72
45	Lindberg, Donald AB, Betsy L. Humphreys, and Alexa T. McCray. "The unified medical language system." IMIA Yearbook (1993)	557	50.91	49
46	Jonsson, E. Niclas, and Mats O. Karlsson. "Xpose—an S-PLUS based population pharmacokinetic/pharmacodynamic model building aid for NONMEM." Computer methods and programs in biomedicine 58.1 (1998)	553	23.21	73
47	Pencina, Michael J., Ralph B. D'Agostino, and Ramachandran S. Vasan. "Evaluating the added predictive ability of a new marker: from area under the ROC curve to reclassification and beyond." Statistics in medicine 27.2 (2008)	535	30.72	65
48	Lipkus, Isaac M., Greg Samsa, and Barbara K. Rimer. "General performance on a numeracy scale among highly educated samples." Medical decision making 21.1 (2001)	530	41.15	17
49	Normand, S. L. T. "Meta-analysis: formulating, evaluating, combining and reporting." Statistics in medicine (1999).	529	33.12	24
50	Beck, J. Robert, and Stephen G. Pauker. "The Markov process in medical prognosis." Medical Decision Making 3.4 (1983)	526	29.39	36
51	Clayton, D., and E. Schifflers. "Models for temporal variation in cancer rates. II: age–period–cohort models." Statistics in medicine 6.4 (1987)	525	15.47	40
52	Carpenter, James, and John Bithell. "Bootstrap confidence intervals: when, which, what? A practical guide for medical statisticians." Statistics in medicine 19.9 (2000)	516	17.5	41
53	Pacini, Giovanni, and Richard N. Bergman. "MINMOD: a computer program to calculate insulin sensitivity and pancreatic responsivity from the frequently sampled intravenous glucose tolerance test." Computer methods and programs in biomedicine 23.2 (1986)	513	30.35	47
54	J Sweeting, Michael, Alexander J Sutton, and Paul C Lambert. "What to add to nothing? Use and avoidance of continuity corrections in meta-analysis of sparse data." Statistics in medicine 23.9 (2004)	511	16.55	53
55	Cope, M., and David T. Delpy. "System for long-term measurement of cerebral blood and tissue oxygenation on newborn infants by near infra-red transillumination." Medical and Biological Engineering and Computing 26.3 (1988)	506	39.31	50
56	Eysenbach, Gunther. "The law of attrition." Journal of medical Internet research 7.1 (2005)	506	42.17	99

Table 3 (continued)

Rank	Article	Citations	Citation per year	Rank by citation per year
57	Cnaan, Avital, N. M. Laird, and Peter Slasor. "Tutorial in biostatistics: using the general linear mixed model to analyse unbalanced repeated measures and longitudinal data." Statistics in medicine 16 (1997)	499	17.45	63
58	Whitehead, Anne, and John Whitehead. "A general parametric approach to the meta-analysis of randomized clinical trials." Statistics in medicine 10.11 (1991)	492	24.95	28
59	D'Agostino, Ralph B., et al. "Relation of pooled logistic regression to time dependent Cox regression analysis: the Framingham Heart Study." Statistics in medicine 9.12 (1990)	481	18.92	96
60	Miettinen, Olli, and Markku Nurminen. "Comparative analysis of two rates." Statistics in medicine 4.2 (1985)	474	17.81	86
61	Bates, David W., et al. "The impact of computerized physician order entry on medication error prevention." Journal of the American Medical Informatics Association 6.4 (1999)	468	14.81	38
62	Bates, David W., et al. "Ten commandments for effective clinical decision support: making the practice of evidence-based medicine a reality." Journal of the American Medical Informatics Association 10.6 (2003)	468	33.43	98
63	Macaskill, Petra, Stephen D. Walter, and Les Irwig. "A comparison of methods to detect publication bias in meta-analysis." Statistics in medicine 20.4 (2001)	466	29.12	64
64	Hirth, Richard A., et al. "Willingness to pay for a quality-adjusted life year in search of a standard." Medical Decision Making 20.3 (2000)	458	26.94	79
65	Rosse, Cornelius, and José LV Mejino. "A reference ontology for biomedical informatics: the Foundational Model of Anatomy." Journal of biomedical informatics 36.6 (2003)	455	32.5	80
66	Clayton, D., and E. Schifflers. "Models for temporal variation in cancer rates. I: age–period and age–cohort models." Statistics in medicine 6.4 (1987)	453	15.1	67
67	Littell, Ramon C., Jane Pendergast, and Ranjini Natarajan. "Tutorial in biostatistics: modelling covariance structure in the analysis of repeated measures data." Statistics in medicine 19.1793 (2000)	451	26.53	81
68	Tibshirani, Robert. "The lasso method for variable selection in the Cox model." Statistics in medicine 16.4 (1997)	445	22.25	19
69	Sankoh, Abdul J., Mohammad F. Huque, and Satya D. Dubey. "Some comments on frequently used multiple endpoint adjustment methods in clinical trials." Statistics in medicine 16.22 (1997)	440	22	58
70	Yusuf, Salim, Rory Collins, and Richard Peto. "Why do we need some large, simple randomized trials?." Statistics in medicine 3.4 (1984)	438	13.27	93
71	Vickers, Andrew J., and Elena B. Elkin. "Decision curve analysis: a novel method for evaluating prediction models." Medical Decision Making 26.6 (2006)	437	39.73	76
72	Dickman, Paul W., et al. "Regression models for relative survival." Statistics in medicine 23.1 (2004)	432	33.23	43
73	Higgins, Julian, and Simon G. Thompson. "Controlling the risk of spurious findings from meta-regression." Statistics in medicine 23.11 (2004)	424	32.62	92
74	Stinnett, Aaron A., and John Mullahy. "Net health benefits a new framework for the analysis of uncertainty in cost-effectiveness analysis." Medical decision making 18.2 suppl (1998)	415	21.84	37
75	DeMets, David L. "Methods for combining randomized clinical trials: strengths and limitations." Statistics in medicine 6.3 (1987)	414	13.8	46
76	Chinn, Susan. "A simple method for converting an odds ratio to effect size for use in meta-analysis." Statistics in medicine 19.22 (2000)	413	24.29	68

Table 3 (continued)

Rank	Article	Citations	Citation per year	Rank by citation per year
77	Van Buuren, Stef. "Multiple imputation of discrete and continuous data by fully conditional specification." Statistical methods in medical research 16.3 (2007)	406	40.6	69
78	Karantonis, Dean M., et al. "Implementation of a real-time human movement classifier using a triaxial accelerometer for ambulatory monitoring." IEEE transactions on information technology in biomedicine 10.1 (2006)	406	36.91	44
79	Pocock, Stuart J., et al. "Subgroup analysis, covariate adjustment and baseline comparisons in clinical trial reporting: current practiceand problems." Statistics in medicine 21.19 (2002)	404	26.93	74
80	Heinze, Georg, and Michael Schemper. "A solution to the problem of separation in logistic regression." Statistics in medicine 21.16 (2002)	400	26.67	25
81	Lumley, Thomas. "Network meta-analysis for indirect treatment comparisons." Statistics in medicine 21.16 (2002)	395	26.33	59
82	Haynes, R. Brian, et al. "Developing optimal search strategies for detecting clinically sound studies in MEDLINE." Journal of the American Medical Informatics Association 1.6 (1994)	395	17.17	60
83	Zeger, Scott L., and Kung-Yee Liang. "An overview of methods for the analysis of longitudinal data." Statistics in medicine 11.14–15 (1992)	395	15.8	85
84	Austin, Peter C. "Balance diagnostics for comparing the distribution of baseline covariates between treatment groups in propensity-score matched samples." Statistics in medicine 28.25 (2009)	390	48.75	52
85	Jaro, Matthew A. "Probabilistic linkage of large public health data files." Statistics in medicine 14.5–7 (1995)	388	17.64	57
86	Muggeo, Vito MR. "Estimating regression models with unknown break-points." Statistics in medicine 22.19 (2003)	382	27.29	82
87	Rosner, B., W. C. Willett, and D. Spiegelman. "Correction of logistic regression relative risk estimates and confidence intervals for systematic within-person measurement error." Statistics in medicine 8.9 (1989)	381	13.61	90
88	Austin, Peter C. "A critical appraisal of propensity-score matching in the medical literature between 1996 and 2003." Statistics in medicine 27.12 (2008)	380	42.22	54
89	Freedman, Laurence S., Barry I. Graubard, and Arthur Schatzkin. "Statistical validation of intermediate endpoints for chronic diseases." Statistics in medicine 11.2 (1992)	380	15.2	83
90	Berkey, Catherine S., et al. "A random-effects regression model for meta-analysis." Statistics in medicine 14.4 (1995)	377	17.14	51
91	Donner, Allan, and Michael Eliasziw. "Sample size requirements for reliability studies." Statistics in medicine 6.4 (1987)	377	12.57	89
92	Bates, David W., et al. "Reducing the frequency of errors in medicine using information technology." Journal of the American Medical Informatics Association 8.4 (2001)	373	23.31	66
93	Gauderman, W. James. "Sample size requirements for matched case-control studies of gene–environment interaction." Statistics in medicine 21.1 (2002)	370	24.67	61
94	McNeil, Barbara J., and James A. Hanley. "Statistical approaches to the analysis of receiver operating characteristic (ROC) curves." Medical decision making 4.2 (1984)	367	11.12	75
95	Austin, Peter C., Paul Grootendorst, and Geoffrey M. Anderson. "A comparison of the ability of different propensity score models to balance measured variables between treated and untreated subjects: a Monte Carlo study." Statistics in medicine 26.4 (2007)	363	36.3	87

Table 3 (continued)

Rank	Article	Citations	Citation per year	Rank by citation per year
96	Sullivan, Lisa M., Joseph M. Massaro, and Ralph B. D'Agostino. "Presentation of multivariate data for clinical use: The Framingham Study risk score functions." Statistics in medicine 23.10 (2004)	363	27.92	70
97	Laird, Nan M. "Missing data in longitudinal studies." Statistics in medicine 7.1–2 (1988)	361	12.45	91
98	Lunceford, Jared K., and Marie Davidian. "Stratification and weighting via the propensity score in estimation of causal treatment effects: a comparative study." Statistics in medicine 23.19 (2004)	354	27.23	97
99	Thakkinstian, Ammarin, et al. "A method for meta-analysis of molecular association studies." Statistics in medicine 24.9 (2005)	350	29.17	100
100	Begg, Colin B. "Biases in the assessment of diagnostic tests." Statistics in medicine 6.4 (1987)	346	11.53	94

Informatics field, i.e. that the body of literature has flourished in recent years and researchers tend to rely on the latest guidelines. A review of citations in Fig. 1 shows that the authors of the Medical Informatics articles use more up-to-date resources than the forty papers originally published in the 2000s. Noteworthy, all papers in the list of Top cited 100 articles that were retrieved by keyword (ii procedure) were also retrieved through journals related to Medical Informatics searches (i procedure). In other words, all the articles that were retrieved using key words could also be retrieved through the journals search.

Limitations

As with all bibliometric analyses, our study has limitations. The primary limitation is the use of search terms in the creation of the study database. Articles that did not contain our query terms were not retrieved and included in our analysis. However, we collected all journals that published articles in Medical Informatics according to the WOS "Medical Informatics" category. Another limitation is that Medical Informatics is a multidisciplinary field, and Medical

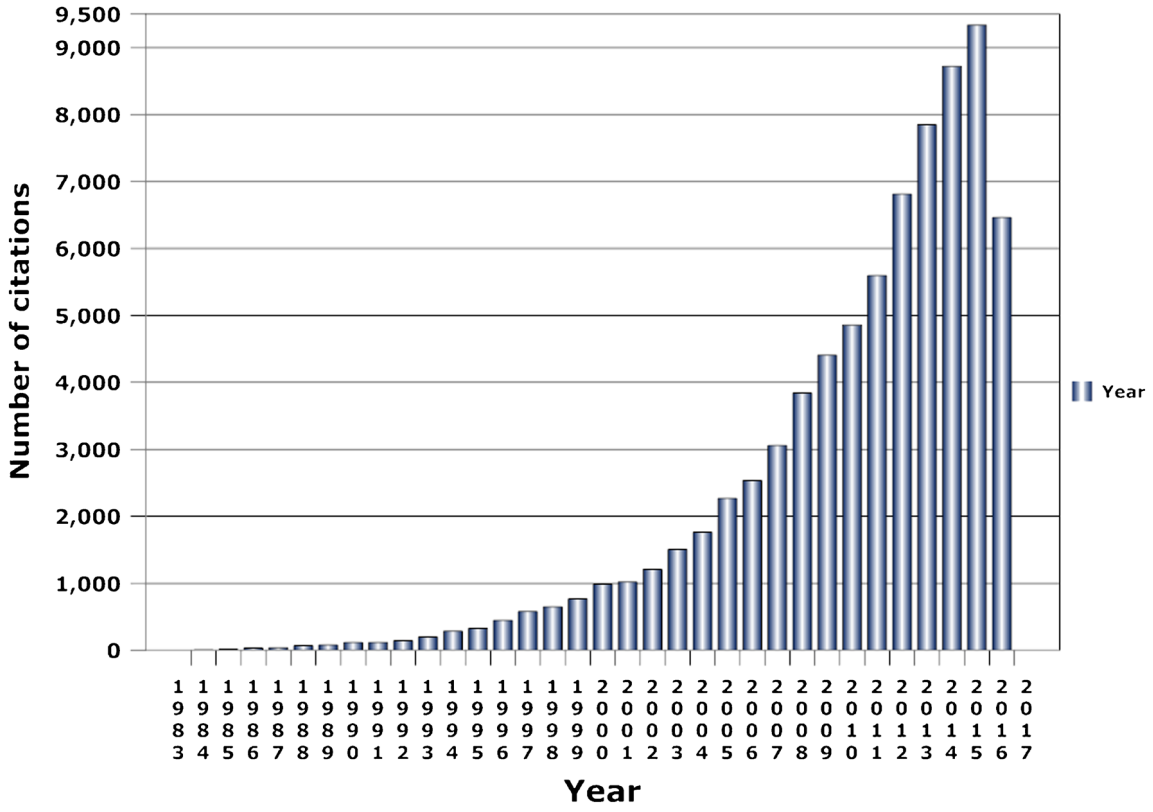


Fig. 2 The distribution of the 100 top cited articles by Citations per year, Web of Knowledge

Informatics articles may be published in non-specialized journals. WOS may not always index them using the Medical Informatics category, and too, recognize their articles which are absolutely related to Medical Informatics are difficult. Moreover, like other bibliometric analyses, our top 100 most cited articles are biased in favor of older publications. However, we also offer the alternative citations per year measure to identify articles with the most impact, regardless of publication year. Finally, articles published in languages other than English might have received unfair citation counts because of bias and poor recognition in the field. Despite these limitations, our investigation provides some insights into the most read and cited articles in the field of Medical Informatics.

Conclusion

This study highlights the role of Medical Informatics in medicine. We found that articles in the statistics and biostatics subarea dominated the Top 100 cited list, followed by articles in the medical artificial intelligence/decision analysis sub-area. We find that our subspecialty bibliometric analyses has revealed the characteristics of highly cited papers, which have implications for Medical Informatics specialists, librarians, researchers, editors, and reviewers. The most cited articles are continuously changing, meaning that the present study provides a snapshot of the most influential articles of the current time, while also showing trends in the literature.

Acknowledgements The authors are grateful to the Research Committee of Urmia University of Medical Sciences, for their valuable supporting of this research.

Authors' Contributions Bahlol Rahimi and Hamed Nadri were the responsible for the study design, data analysis, interpretation of results, and drafting the manuscript.

Toomas Timpka contributed to the design of the study, data analysis, and revision of the manuscript.

Shahram Sedghi contributed to the design of the study and revision of the manuscript.

All authors read and approved the final manuscript.

Compliance with Ethical Standards

Funding There was no funding associated with this research.

Conflict of Interest The authors declare that they have no conflicts of interests.

Research Involving Human Participants and/or Animals This article does not contain any studies with human participants performed by any of the authors.

Informed Consent Not applicable.

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Exhibit 18

Media article on Dr. Marinescu's research in *Adevarul*, one of the most popular and trusted newspapers in Romania. Certified translation in English also attached.

adevărul.ro

Romanian researcher at MIT, in the field of artificial intelligence: "Robots will undertake more and more duties, even though surgeons will continue to lead operations"

By: Ştefan Lică

14 February 2020

https://adevarul.ro/locale/cluj-napoca/cercetator-roman-mit-domeniul-inteligentei-artificiale-robotii-vor-mai-multe-sarcini-chirurgii-vor-continua-conduca-operatiile-1_5e4525095163ec42710d3fb8/index.html

Răzvan Marinescu is a researcher at MIT, the world-renowned US university, where he focuses on the study of computational models for predicting Alzheimer's disease. The Romanian is also the author of a study on the evolution of a rare disease, *posterior cortical atrophy*.

Răzvan Marinescu (29 years old) studied at Imperial College London, after which he further worked on Computer Science and Artificial Intelligence with applications in the field of

medicine for his PhD in Great Britain, at University College London. During his college years, he realized that he is attracted to this field for several reasons:

"In the years 2012-2013 during college, I decided to do research after graduation, because I was very fascinated by the idea of "knowledge "and to help the world progress technologically. I looked into many PhD programs, and was most attracted by those in which computer science is applied to medicine, in order to save or improve people's lives. It was then when I realized that computer algorithms can be used to improve diagnoses received by patients, discover new treatments, or understand huge datasets that could not be analyzed manually, " says the researcher.

The first challenges

The next step was relatively simple. To follow his plans, he studied the profile of his university professors, and met Professor Daniel Rueckert, one of the best known specialists in researching "machine learning" algorithms for medical imaging. He advised him to pursue a doctorate at the prestigious University College London, one of the world's top universities. Arriving here, he initially struggled at first during his PhD, and the taste for success was delayed for several months.

"In my first years at UCL, I took advanced courses in Statistics and Machine Learning, but I also had a stressful period. For example, in my first research project there, I worked for about 6-7 months without getting the desired results. We were working on some new

algorithms that should have performed better than the classic algorithms, but in reality there was no difference between them, and I didn't understand why. At that point, my coordinating professor helped me a lot, and suggested a much more interesting direction of research that I then followed. After I started working in a new direction, things went much better and I soon became an independent researcher. This meant that I was myself suggesting new research directions, and my coordinating professor was very satisfied and supported me to work on these new ideas ", says Răzvan.

A new challenge, the famous MIT

After completing his PhD at University College London, the young researcher needed a challenge. That's why he chose MIT, one of the top universities across the ocean, where he is pursuing a postdoctoral fellowship. In the United States, he focuses on the study of computational models for predicting Alzheimer's disease. In other words, his studies are related to the application of artificial intelligence in medicine.

“The main applications of artificial intelligence in medicine are generally related to the analysis of medical images: estimating the diagnosis, locating and delineating the pathology (for example, the algorithms will establish that the brain lesion is here in location X and has the Y contour) as well as the reconstruction of clearer and better medical images (reducing the artifacts caused by the movement of patients in the MRI scanner). In my opinion, the revolution, if you can call it that, is underway - many people are now working on machine learning or, in other words, artificial intelligence, with applications in medicine, which will soon revolutionize the medical system”, says Răzvan.

"At MIT, since I came here, I've been working on computational models for predicting Alzheimer's disease, which I also worked on during my PhD at UCL. These models can predict, using brain images as well as genetic data, when certain people will develop Alzheimer's disease and what their trajectory will be. My most impactful achievement was to analyze the predictions of 62 algorithms in the TADPOLE competition. These are algorithms that predict when certain people at risk for Alzheimer's will develop the disease. In addition to this analysis, I was one of the main organizers of the competition, and managed to create a community of about 100 researchers interested in machine learning models for predicting Alzheimer's disease ", explains Răzvan.

Another important project he is working on is the study of the evolution of a rare disease, posterior cortical atrophy. The study is being conducted in collaboration with researchers at the Dementia Research Center in London. In this field, Răzvan and his collaborators have already published a study.

"My second most important project was to analyze the evolution of a rare neurodegenerative disease, Posterior Cortical Atrophy, for which did not know exactly its evolution due to lack of data and appropriate models. Our collaborators at the Dementia Research Center in London collected a set of images from about 100 patients with posterior cortical atrophy, which allowed us to apply more sophisticated progression models that reconstructed the evolution of the disease. This year we published the first study that systematically analyzes the evolution of this rare form of degenerative disease ", says the young researcher.

The future might look like SF movies

Răzvan Marinescu is convinced that in the not too distant future, artificial intelligence will change the face of some fields of medicine. Sophisticated equipment and robots could replace, to some extent, certain doctors, but in a much more distant time horizon.

"In the next 10-20 years, many systems will appear in hospitals that will completely transform radiology. In other areas, such as surgery, more efficient robots will also appear, but here it will take longer, and doctors will stay in control the operations for a while. In the end, areas such as psychology and psychotherapy will probably be the last to be changed by artificial intelligence, because in order to make a machine understand complex, high-level conditions, such as depression or anxiety, we must first learn to solve low-level tasks. For automating tasks in the field of psychology, I think it will take at least 70-90 years before we can attack the problem", predicts the Romanian researcher from MIT.

Even if Romania lags far behind the developed states in terms of artificial intelligence, Răzvan Marinescu does not rule out a possible return to the country. In fact, the young man is considering returning to Romania, to teach in the university environment and to put his shoulder to the development of research.

"I have not yet decided where I will settle after completing my postdoctoral studies at MIT. In principle, I would consider returning to Romania to become a university professor to support research there. The advantages of doing research in Romania would be that I can gather the best students to work with me, and I think there is a lot of talent in Romania that I can work with. The disadvantages would be that there is not a well-developed scientific community, and the creation of such a community would be something we should all additionally work on. In addition, there is little capital available for research in Romania, although this has recently started to change with the availability of EU funds", concludes Răzvan Marinescu.

Translator's certificate

I, [translator's full name], certify that I am fluent (conversant) in English and Romanian, and that the above document is an accurate translation of the document attached entitled *"Cercetător român la MIT, în domeniul inteligenţei artificiale: „Roboţii vor avea tot mai multe sarcini, chiar dacă chirurgii vor continua să conducă operaţiile".*

Signed:

Full name

Dated: June 25, 2021

Address: XXX

Cercetător român la MIT, în domeniul inteligenţei artificiale: „Roboţii vor avea tot mai multe sarcini, chiar dacă chirurgii vor continua să conducă operaţiile“

De: Ştefan Lică,

14 February 2020

https://adevarul.ro/locale/cluj-napoca/cercetator-roman-mit-domeniul-inteligentei-artificiale-robotii-vor-mai-multe-sarcini-chirurgii-vor-continua-conduca-operatiile-1_5e4525095163ec42710d3fb8/index.html

Răzvan Marinescu este cercetător la celebra universitate americană MIT, unde se concentrează pe studiul unor modele computaţionale pentru prezicerea bolii Alzheimer. Românul este şi autorul unui studiu asupra evoluţiei unei boli rare, artrofia corticală posterioară.

Răzvan Marinescu (29 de ani) a studiat la Imperial College din Londra, după care a aprofundat studiile de informatică şi inteligenţă artificială cu aplicaţii în domeniul medicinei şi a urmat un doctorat tot în Marea Britanie, la University College din Londra. Asta după ce, în anii studenţiei, a realizat că este atras de acest domeniu din mai multe motive.

„În anii 2012-2013 în perioada facultăţii, m-am hotărât să fac cercetare după ce termin studiile, fiindcă eram foarte fascinat de ideea de «cunoaştere» (knowledge) şi de a ajuta lumea să progreseze din punct de vedere tehnologic. Am studiat atunci multe programe de doctorat, iar cel mai atras am fost de cele în care se aplică informatică în medicină, pentru a ajută să salvez sau să îmbunătăţesc viaţa oamenilor. Atunci mi-am dat seama că algoritmi informatici pot fi folosiţi pentru a îmbunătăţii diagnosticele primite de pacienţi, descoperirea de tratamente noi, sau înţelegea unor seturi de date imense care apăruseră recent care nu pot fi analizate manual”, rememorează cercetătorul.

Primele greutăţi

Următorul pas a fost relativ simplu. Pentru a-şi urma planurile, a studiat pe profilul profesorilor şi l-a cunoscut pe profesorul Daniel Rueckert, unul dintre cei mai cunoscuţi specialişti în cercetarea algoritmilor de „machine learning” pentru imagistică medicală. Acesta l-a sfătuit să urmeze un doctorat la prestigioasa University College Londra, una dintre universităţile de top ale lumii. Ajuns aici, a dat într-o primă fază de greu, iar gustul succesului a întârziat să apară, timp de câteva luni.

„La UCL, în primii ani, am luat cursuri avansate în statistică şi machine learning, dar am avut şi o perioadă stresantă. De exemplu, la primul proiect de cercetare am lucrat vreo 6-7 luni

fără să obţin rezultatele dorite. Practic, lucram la nişte algoritmi noi care ar fi trebuit să aibă o performanţă mai bună decât algoritmii clasici, dar în realitate nu era nicio diferenţa între ei, iar eu nu înţelegeam de ce. În acel moment, profesorul meu coordonator m-a ajutat foarte mult, şi mi-a sugerat o direcţie mult mai interesantă de cercetare pe care am urmat-o apoi. După ce am început să lucrez pe o nouă direcţie, lucrurile au mers mult mai bine şi în scurt timp am devenit cercetător independent. Asta însemna că veneam eu însumi cu propuneri de proiecte, iar profesorul coordonator era foarte mulţumit şi mă susţinea să lucrez la aceste noi idei", povesteşte Răzvan.

O nouă provocare, celebra MIT

După terminarea doctoratului la University College London, tânărul cercetător avea nevoie de o provocare. Aşa a ales MIT, una dintre universităţile de top de peste Ocean, unde urmează şi un postdoctoral. În Statele Unite ale Americii, el se concentrează pe studiul unor modele computaţionale pentru prezicerea bolii Alzheimer. Sau altfel spus, studiile sale ţin de aplicaţiile inteligenţei artificiale în medicină.

Principalele aplicaţii ale inteligenţei artificiale în medicină sunt în general legate de analiza de imagini medicale: estimarea diagnosticului, localizarea şi delinierea patologiei (de exemplu, vor stabili că leziunea din creier este aici în locaţia X şi are conturul Y) şi reconstrucţia de imagini medicale mai clare şi mai bune (mă gândesc reducerea artefactelor cauzate de mişcarea pacienţilor în scannerul RMN). În opinia mea, revoluţia, dacă se poate numi aşa, este în curs -- multă lume lucrează acum la machine learning sau, altfel spus, inteligenţa artificială cu aplicaţii în medicină, care în curând o să revoluţioneze sistemul medical.

„La MIT, de când am venit, încă termin lucrul la modele computationale pentru prezicerea bolii Alzheimer, la care am lucrat în timpul doctoratului la UCL. Aceste modele pot să prezică, folosind imagini din creier precum şi date genetice, când anumite persone vor dezvoltă boală Alzheimer şi care va fi traiectoria acestora. Cea mai de impact realizare a mea a fost să analizez prezicerile a 62 de algoritmi din competiţia TADPOLE, algoritmi care prezic când anumiţi oameni cu risc de Alzheimer vor dezvoltă boală. Pe lângă această analiză, am fost şi unul din principalii co-organizatori ai competiţiei, şi am reuşit să creăm o comunitate de aproximativ 100 de oameni interesată de modele de machine learning pentru prezicerea bolii Alzheimer", explică Răzvan.

Un alt proiect important la care lucrează este studiul evoluţiei unei boli rare, artrofia corticală posterioară. Studiul este făcut în colaborarea cu cercectătorii Centrului Cercetare a Demenţei din Londra. În acest domeniul Răzvan şi colaboratorii săi au publicat deja un studiu.

„Al doilea cel mai important proiect al meu a fost să analizez evoluţia unei boli neurodegenerative rare, atrofie corticală posterioară (Posterior Cortical Atrophy), despre care nu se ştia exact evoluţia din lipsa de date şi modele corespunzătoare. Colaboratorii noştri de la centrul de cercetare a demenţei din Londra (Dementia Research Center) au colectat un set de imagini de la aproximativ 100 de pacienţi cu atrofie corticală posterioară,

care ne-a permis să aplicăm nişte modele de progresie mai complexe ce reconstruiau evoluţia bolii. Am publicat aşadar anul acesta primul studiu care analizează sistematic evoluţia acestei forme rare de boală degenerativă", arată tânărul cercetător.

Viitorul ar putea să semene cu filmele SF

Răzvan Marinescu este convins că într-un viitor deloc îndepărtat, intelgenţa artificială va schimba la faţă unele domenii ale medicinei. Aparatura sofisticată şi roboţii ar putea înlocui, într-o oarecare măsură, şi anumiţi medici, însă asta într-un orizont de timp mult mai îndepărtat.

„În următorii 10-20 de ani, vor apărea multe sisteme în spitale care vor transforma complet radiologia. În alte domenii, precum cel chirurgical, vor apărea de asemenea roboţi mai performanţi, dar aici va dura mai mult, iar doctorii încă vor rămâne o perioada cei care controlează operaţiile. În final, domenii precum psihologia şi psihoterapia vor fi probabil ultimele care vor fi schimbate de inteligenţa artificială, fiindcă pentru a face o maşină să înţeleagă taskuri high-level (depresie sau anxietate), trebuie întâi să le învăţăm să rezolve taskuri low-level. Pentru automatizarea domeniului psihologiei, cred că va dura cel puţin 70-90 de ani până să putem ataca problema", prezice cercetătorul român de la MIT.

Chiar dacă România se află mult în urma statelor dezvoltate în ce priveşte intelgenţa artificială, Răzvan Marinescu nu exclude o eventuală întoarcere în ţară. De altfel, tânărul se gândeşte să revină în România, pentru a preda în mediul universitar şi pentru a pune umărul la dezvoltarea cercetării.

„Încă nu m-am hotărât unde o să mă stabilesc după ce termin studiile post-doctorande la MIT. În principiu, mi-ar plăcea să mă întorc în România şi să devin profesor universitar pentru a sprijini cercetarea de acolo. Avantajele de a face cercetare în România ar fi că pot strânge cei mai buni studenţi să lucreze cu mine, şi cred că este foarte mult talent în România cu care pot lucra. Dezavantajele ar fi că nu există comunitate ştiinţifică bine devoltata, şi crearea unei astfel de comunităţi ar fi ceva în plus de care ar trebui să ne ocupăm cu toţii. În plus, în România este puţin capital disponibil pentru cercetare, dar acest lucru a început să se schimbe odată cu disponibilitatea fondurilor europene”, încheie Răzvan Marinescu.

Adevărul

Adevărul (Romanian pronunciation: [adeˈvərul]; meaning "The Truth", formerly spelled ***Adevĕrul***) is a Romanian daily newspaper, based in Bucharest. Founded in Iași, in 1871, and reestablished in 1888, in Bucharest, it was the main left-wing press venue to be published during the Romanian Kingdom's existence, adopting an independent pro-democratic position, advocating land reform, and demanding universal suffrage. Under its successive editors Alexandru Beldiman and Constantin Mille, it became noted for its virulent criticism of King Carol I. This stance developed into a republican and socialist agenda, which made *Adevărul* clash with the Kingdom's authorities on several occasions. As innovative publications which set up several local and international records during the early 20th century, *Adevărul* and its sister daily *Dimineața* competed for the top position with the right-wing *Universul* before and throughout the interwar period. In 1920, *Adevărul* also began publishing its prestigious cultural supplement, *Adevărul Literar și Artistic*. By the 1930s, their anti-fascism and the Jewish ethnicity of their new owners made *Adevărul* and *Dimineața* the targets of negative campaigns in the far right press, and the antisemitic Octavian Goga cabinet banned both upon obtaining power in 1937. *Adevărul* was revived by Barbu Brănișteanu after World War II, but was targeted by Communist Romania's censorship apparatus and again closed down in 1951.

A newspaper of the same name was set up in 1989, just days after the Romanian Revolution, replacing *Scînteia*, organ of the defunct Romanian Communist Party. Initially a supporter of the dominant National Salvation Front, it adopted a controversial position, being much criticized for producing populist and radical nationalist messages and for supporting the violent Mineriad of 1990. Under editors Dumitru Tinu and Cristian Tudor Popescu, when it reasserted its independence as a socially conservative venue and was fully privatized, *Adevărul* became one of the most popular and trusted press venues. Nevertheless, it remained involved in scandals over alleged or confirmed political and commercial dealings, culminating in a 2005 conflict which saw the departure of Popescu, Bogdan Chireac and other panelists and the creation of rival newspaper *Gândul*. As of 2006, *Adevărul* had been the property of Dinu Patriciu, a prominent Romanian businessman and politician.

Adevărul

Adevărul logo

Type	Daily newspaper
Format	compact
Owner(s)	Cristian Burci
Editor	Adevărul Holding
Staff writers	18[1]
Founded	1871 (reestablished 1888, 1919, 1946, 1989)
Headquarters	21 Fabrica de Glucoză Street, Sector 2
City	Bucharest
Country	Romania
ISSN	1016-7587 (https://www.worldcat.org/search?fq=x0:jrnl&q=n2:1016-7587)
Website	www.adevarul.ro (http://www.adevarul.ro/)

Media of Romania
List of newspapers

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Ownership, editorial team and structure

Adevărul is the main trademark of Adevărul Holding, a company owned by Cristian Burci. The main newspaper itself is edited by editor-in-chief Dan Marinescu and several deputy editors (Liviu Avram, Adina Stan, Andrei Velea and others).[1] Also part of the holding are the cultural magazines *Dilema Veche* and *Historia*, the tabloid *Click!*, the magazines Click! pentru femei, Click! Sănătate, Click! Poftă bună! and OK! Magazine.

In December 2010, Adevărul Holding also launched a sister version of its title asset, published in neighboring Moldova as *Adevărul Moldova*.[2]

The Romanian newspaper had special pages of regional content, one each for Bucharest, Transylvania, Moldavia, the western areas of Banat and Crişana, and the southern areas of Wallachia and Northern Dobruja. It also hosts columns about the larger sections of Romanian diaspora in Europe, those in Spain and Italy. *Adevărul* publishes several supplements. In addition to *Adevărul Literar şi Artistic* (formerly a separate magazine, now issued as a culture supplement which is issued on Wednesdays), it publishes five others: on Mondays, the sports magazine *Antifotbal* ("Anti-football"), which focuses on the traditionally less-covered areas of the Romanian sports scene; on Tuesdays, *Adevărul Expert Imobiliar* ("Real Estate Expert"); on Thursdays, *Adevărul Sănătate* ("Health"), a health and lifestyle magazine; on Fridays, a TV guide, *Adevărul Ghid TV*, followed on Sundays by the entertainment section *Magazin de Duminică* ("Sunday Magazine"). In October 2008, *Adevărul* also launched *Adevărul de Seară* ("Evening Adevărul"), a free daily newspaper and evening edition, which was closed down in May 2011.[3]

As of 2008, the newspaper publishes *Colecţia Adevărul*, a collection of classic and popular works in world and Romanian literature. These are issued as additional supplements, and sold as such with the newspaper's Thursday editions.

History

1871 and 1888 editions

Origins

A newspaper by the name *Adevĕrulŭ* (pronounced the same as *Adevărul*, but following versions of the Romanian alphabet which emphasized etymology, in this case from the Latin word *veritas*) was founded on December 15, 1871.[4] The weekly was owned by Alexandru Beldiman, a former Police commander, and published in Iaşi, the former capital of Moldavia. Beldiman directed the newspaper in opposition to Romania's new *Domnitor*, the German prince Carol of Hohenzollern, calling for the restoration of his deposed and exiled predecessor, the Moldavian-born Alexandru Ioan Cuza.[4] Its articles against the new monarch soon after resulted in Beldiman's indictment for defamation and attack on the 1866 Constitution.[4] He was eventually acquitted, but the journal ceased publication with its 13th issue (April 1872).[4]

The *Adeverulu* published in Iași (front page of the first issue in the 1871 series).

Adevărul reemerged as a daily on August 15, 1888, seven years after the proclamation of a Romanian Kingdom. It was then known as *Adevĕrul*, which also reflected the *veritas* origin, and the *ĕ*, although obsolete by the early 20th century, was kept as a distinctive sign by all the paper's owners until 1951.[4][5] Initially financed by a printer, who agreed to advance it a short-term credit,[6] the new gazette was co-founded by Alexandru Beldiman and Alexandru Al. Ioan, the son of former *Domnitor* Cuza, and was again noted for its radical and often irreverent critique of newly crowned King Carol and the "foreign dynasty".[4][5][7][8] The small editorial team included writer Grigore Ventura and his son Constantin, as well as, after a while, political columnist I. Hussar.[7] In December 1888, it changed its format, from a No. 6 to a No. 10 in paper size, while abandoning the initial, calligraphed logo, in favor of a standard serif which it used until 1951.[7]

First version of the *Adevĕrul* logo (front page of the first issue in the 1888 series). A similar version was used in the early 1990s (*Adevărul*, in light blue, with identical typeface).

Beldiman's hostility to the monarchy was reflected in one of the 15 objectives set by the second series' first issue, whereby *Adevărul* called for an elective monarchy with magistratures reserved for locals,[7] and evident in having chosen for the paper's motto a quote from poet Vasile Alecsandri, which read: *Să te ferescĭ, Române!, de cuiŭ strein în casă* ("Romanians, beware of foreign nails in your house", an allusion to Carol's German origin).[4][5][7][9] The journalists called Carol's accession to the throne by the 1866 plebiscite "an undignified comedy",[8] refused to capitalize references to *M. S. Regele* ("H[is] M[ajesty] the King"),[4] and referred to May 10, the national celebration of the Kingdom, as a "national day of mourning".[4][10] In December 1888, they also published a list of Carol's alleged attacks on Romanian dignity.[11] According to one account, after the newspaper's first May 10 issue came out in 1889, Police forces bought copies which they later set on fire.[10] Reportedly, its circulation peaked on May 10 of each year, from some 5,000 to some 25,000 or 30,000 copies.[4][12] *Adevărul* also debated with the German newspapers *Norddeutsche Allgemeine Zeitung* and *Kölnische Zeitung*, who worried that Romania's anti-dynasticists plotted Carol's murder, assuring them that the actual battle was political, "in broad daylight, on the wide path of public opinion."[8] In 1891, the paper called for boycotting Carol's 25th anniversary on the throne.[8]

Early campaigns

Located in Bucharest, the new *Adevărul* had its original headquarters in Calea Victoriei (Doamnei Street, Nouă Street, Brătianu Boulevard and Enei Street).[7][13] It later moved to a building near the National Bank and the Vilacrosse Passage, where it occupied just several rooms (leading its staff to repeatedly complain about the lack of space).[5][13][14] A serious crisis occurred during 1892, when, having omitted to register his trademark, Beldiman was confronted with the appearance of a competing *Adevărul*, published by his former associate Toma Basilescu, who had been the original gazette's administrator for the previous year.[10] In June 1892, an arbitral tribunal decided in favor of Beldiman, ordering Basilescu to close down his paper.[10]

With time, the newspaper had moved from advocating King Carol's replacement with a local ruler to supporting republicanism.[8] In 1893, as part of its extended campaign, during which it gathered letters of protest from its readers, *Adevărul* obtained the cancellation of plans for a public subscription to celebrate the engagement of Crown Prince Ferdinand to Marie of Edinburgh.[8] In addition, *Adevărul* began militating for a number of major social and political causes, which it perceived as essential to democracy. In its 15 points of 1888, it notably demanded universal suffrage to replace the census method enshrined in the 1866 Constitution, unicameralism through a disestablishment of the Senate, a land reform to replace leasehold estates, self-governance at a local level, progressive taxation, Sunday rest for employees, universal conscription instead of a permanent under arms force, women's rights, emancipation for Romanian Jews.[7] It embraced the cause of Romanians living outside the Old Kingdom, particularly those in Austro-Hungarian-ruled Transylvania,[7][8] while calling for Romania to separate itself from its commitment to the Triple Alliance, and advocating a Balkan Federation to include Romania.[7]

Adevărul also took an active interest in the problems facing Romania's rural population: while calling for a land reform, it expressed condemnation of the failing sanitary system, which it blamed for the frequency of countryside epidemics, and for the administrative system, which it accused of corruption.[8] It depicted revolt as legitimate, and campaigned in favor of amnesty for prisoners taken after the 1888 peasant riots.[8] The paper supported educational reforms in the countryside, calling attention to the specific issues faced by rural teachers, but also campaigned against their use of corporal punishment as a method of maintaining school discipline.[8] In similar vein, *Adevărul* focused on cases of abuse within the Romanian Army, documenting cases where soldiers were being illegally used as indentured servants, noting the unsanitary conditions which accounted for an unusually high rate of severe conjunctivitis, and condemning officers for regularly beating their subordinates.[8] As part of the latter campaign, it focused on Crown Prince Ferdinand, who was tasked with instructing a battalion and is said to have slapped a soldier for not performing the proper moves.[8] *Adevărul* investigated numerous other excesses of authority, and on several occasions formed special investigative commissions of reporters who followed suspicions of judicial error.[8] It also spoke out in favor of Jewish emancipation, while theorizing a difference between the minority "exploiting Jews" and an assimilable Jewish majority.[8]

Under Beldiman, the newspaper took pride in stating its independence, by taking distance from the two dominant parties, the Conservatives and the National Liberal Party, who either supported or tolerated King Carol.[4] This stance reputedly earned the publication an unusual status: anecdotes have it that Conservative leader Lascăr Catargiu would only read *Adevărul* while in the opposition, and that its columnist Albert Honigman was the first and for long time only journalist allowed into the upper-class society at Casa Capşa restaurant.[14] In February 1889, the Conservative Premier Theodor Rosetti reputedly tried to silence *Adevărul* by having its distributors arrested.[10] In 1892, *Adevărul* became the first local newspaper to feature a cartoonist section, which hosted caricatures of the period's potentates, and its rebelliousness allegedly frightened the Romanian zincographers to the point where the plates had to be created abroad.[6] In April 1893, the Catargiu cabinet organized a clampdown on the newspaper: it arrested its editor Eduard Dioghenide (who was sentenced to a year in prison on charges of sedition) and, profiting from the non-emancipated status of Romanian Jews, it expelled its Jewish contributors I. Hussar and Carol Schulder.[10] Another incident occurred during May of the following year, when the paper's headquarters were attacked by rioting University of Bucharest students, who were reportedly outraged by an article critical of their behavior, but also believed to have been instigated by the Conservative executive's Gendarmerie.[10]

In parallel, *Adevărul* took steps to establishing its reputation as a newspaper of record. A local first was established in June 1894, when *Adevărul* hosted the first foreign correspondence article received by a Romanian periodical: a telegram sent by the French socialist newspaperman Victor Jaclard, discussing the assassination of Marie François Sadi Carnot and the accession of Jean Casimir-Perier to the office of President.[6] *Adevărul* also broke ground by publishing a plate portrait of Casimir-Perier only a day after his rise to prominence.[6] Early on, the newspaper also had a cultural agenda, striving to promote Romanian literature for the general public and following a method outlined by a 1913 article: "In his free time [...], the reader, having satisfied his curiosity about the daily events, finds entertainment for the soul in the newspaper's literary column. People who would not spend a dime on literary works, will nevertheless read literature once this is made available to them, in a newspaper they bought for the information it provides."[15] Initially, *Adevărul* dedicated its Sunday issue to literary contributions, receiving such pieces from George Coşbuc, Haralamb Lecca, Ioan N. Roman, and the adolescent poet ştefan Octavian Iosif.[15]

Mille's arrival and rise in popularity

By 1893, the gazette's panel came to include several leading activists of the newly created Romanian Social Democratic Workers' Party (PSDMR), among them Constantin Mille and brothers Anton and Ioan Bacalbaşa.[5][14] Mille was an innovator, seen by his contemporaries as a "father of modern Romanian journalism" (a title carved on his tombstone in Bellu cemetery).[5] Although brief, Anton Bacalbaşa's stay also left a distinct mark on *Adevărul*: in 1893, he authored what is supposedly the first interview in Romanian media history.[16] Working together, Mille, Beldiman and Bacalbaşa sought to coalesce the left-wing forces into a single league for universal suffrage, but *Adevărul* soon pulled out of the effort, accusing fellow militant Constantin Dobrescu-Argeş of having embezzled the funds put at his disposal.[17]

In 1895, Mille purchased the newspaper, but, even though the Alecsandri motto was removed a short while after,[5] Beldiman maintained editorial control until his death three years later, explaining that he was doing so in order to maintain an independent line.[4][5] The purchase was received with consternation by many PSDMR members, particularly since *Adevărul* competed with its official platforms (*Munca* and, after 1894, *Lumea Nouă*).[18] In late 1893, *Adevărul* was also publishing articles by an unsigned author, who may have been Constantin Stere (later known as the man behind post-socialist "Poporanism") ridiculing *Munca*'s elitist content.[19]

Eventually, the PSDMR expelled Mille on grounds of having betrayed socialism.[5][18] Allegedly upset that Beldiman had chosen Mille's offer over his own, Anton Bacalbașa quit *Adevărul*, becoming one of Mille's most vocal critics.[5] A third Bacalbașa, Constantin, stayed on, and, from 1895, was Mille's first editor.[20] He became known for his anti-colonial stance, giving positive coverage to the 1896 Philippine Revolution.[21]

Adevărul editors in 1897. Constantin Mille is first seated from left. Standing behind him are Ioan Bacalbașa (middle) and Constantin Bacalbașa (right)

In 1904, the board created Adevĕrul S. A., the first in a series of joint stock companies meant to insure its control of commercial rights.[22] In 1898, after Mille invested its profits into real estate, *Adevărul* left its crowded surroundings and moved to a specially designed new building on Sărindar Street (the present-day C. Mille Street, between Calea Victoriei and the Cișmigiu Gardens). Inspired by *Le Figaro*'s palatial quarters, it was first building of such proportions in the history of Romania's print media, housing a printing press, paper storage, distribution office and mail room, as well as a library, several archives, a phone station and a Romanian Orthodox chapel.[5][6][13] Its halls were luxuriously decorated according to Mille's specifications, and adorned with posters by international artists such as Henri de Toulouse-Lautrec and Alfons Mucha, and by its own occasional illustrator, Nicolae Vermont.[5][13] Around 1900, Mille purchased a neighboring plot, the former Saint-Frères manufacturing plant, and unified both buildings under a single facade.[13] It was there that, after placing an order with the Mergenthaler Company, he installed the first Linotype machines to be used locally.[5][6][12][13]

Adevărul established itself as the most circulated paper, setting up successive records in terms of copies per issue due to Mille's favorable approach to modern printing techniques: from 10,000 in 1894, these brought the circulation to 12,000 in 1895 and 30,000 in 1907.[12] Writing in 1898, Mille took pride in calling his newspaper "a daily encyclopedia" or "cinema" for the regular public, universally available at only 5 bani per copy.[23] In 1904, making efforts to keep up with his rival Luigi Cazzavillan, founder of the right-wing competitor *Universul*,[5] Mille established a morning edition, which was emancipated under separate management in December of the same year, under the new name *Dimineața*. As of 1912, *Dimineața* was the first Romanian daily to use full color print, with a claim to have been the world's first color newspaper.[5][6] Beginning 1905, both gazettes ensured stable revenues by leasing their classified advertising sections to Carol Schulder's Schulder Agency.[6]

Early cultural ventures

In order to consecrate the newspaper's cultural ambitions, Mille became head of a literary club,[5] while he considered creating a separate literary edition. A literary supplement (*Adevĕrul Literar*, "The Literary Truth") was in print between 1894 and 1896, before being replaced by *Adevĕrul Ilustrat* ("The Illustrated Truth") and soon after by *Adevĕrul de Joi* ("The Truth on Thursday"), edited by poet Artur Stavri, and eventually closed down due to lack of funding in 1897.[15] Although short-lived, these publications had a significant part on the cultural scene, and hosted contributions by influential, mostly left-wing, cultural figures: Stavri, Stere, Constantin D. Anghel, Traian Demetrescu, Arthur Gorovei, Ion Gorun, Henric and Simion Sanielevici.[15] In this context, *Adevărul* also began receiving contributions from prominent humorist Ion Luca Caragiale—previously a conservative adversary, known for his mockery of republican sensationalism.[24] In return for the 1897 setback, the gazette began allocating space to serialized works of literature, including sketches by Caragiale (most of the writings later published as *Momente și schițe*), as well as *The Count of Monte Cristo* by Alexandre Dumas, père.[15]

Nicolae Petrescu Găină's caricature of C. I. Stăncescu, original watercolor

The same image, as republished by *Adevărul*

In later years, *Adevărul* experimented by publishing a different supplement each day, including one titled *Litere și Arte* ("Arts and Letters").[15] By the mid-1890s, *Adevărul* was encouraging developments in visual arts in Romania, publishing several original posters,[6] and hosting art chronicles signed with various pseudonyms. In 1895, it covered the artistic environment's split into several competing wings: its columnist, using the pseudonym *Index*, gave a negative review to Nicolae Grigorescu and the other Impressionists or Realists who together had rebelled against the official academic salon of C. I. Stăncescu.[25] The following year however, a chronicler who used the pen name *Gal* praised the anti-academic independents' salon, supporting its members ştefan Luchian, Alexandru Bogdan-Piteşti and Vermont (whose portraits it featured as illustrations for the texts, alongside a notorious caricature of C. I. Stăncescu by Nicolae Petrescu-Găină).[26]

By 1905, *Adevărul* was publishing a supplement titled *Viața Literară* ("The Literary Life", edited by Coșbuc, Gorun and Ilarie Chendi) and two other satirical periodicals, *Belgia Orientului* ("The Orient's Belgium", named after a common sarcastic reference to the Romanian Kingdom) and *Nea Ghiță* ("Uncle Ghiță").[15] It also began running its own publishing house, *Editura Adevĕrul*, noted early on for its editions of Constantin Mille's novels, Caragiale's sketches, and George Panu's memoirs of his time with the literary club *Junimea*.[15] In parallel, Mille reached out into other areas of local culture. Early on, he instituted a tradition of monthly festivities, paid for from his own pocket, and noted for the participation of leading figures in Romanian theater (Maria Giurgea, Constantin Nottara and Aristizza Romanescu among them).[14] Beginning 1905, the paper had for its illustrator Iosif Iser, one of the major graphic artists of his generation, whose satirical drawings most often targeted Carol I and Russian Emperor Nicholas II (attacked for violently suppressing the 1905 Revolution).[27] As a promotional tactic, *Adevărul* participated in the National Fair of 1906, where it exemplified its printing techniques while putting out a collector's version of the newspaper, titled *Adevĕrul la Expoziție* ("Adevĕrul at the Exhibit").[6]

New advocacies and 1907 Revolt coverage

Several mass social, cultural and political campaigns were initiated or endorsed by *Adevărul* before 1910. According to one of Constantin Mille's columns of 1906, the newspaper continued to see itself as an advocate of people's causes: "Any of our readers know that, should any injustice be committed against them, should all authorities discard them, they will still find shelter under this newspaper's roof."[5] In line with Beldiman and Mille's political vision, it militated for a statue of *Domnitor* Cuza to be erected in Iași (such a monument being eventually inaugurated in 1912).[12] Similar initiatives included the 1904 event marking 400 years since the death of Moldavian Prince Stephen the Great, and the erection in Craiova of a bust honoring its deceased contributor, poet Traian Demetrescu.[12] At around the same time, Mille's gazette became a noted supporter of feminism, and created a special column, *Cronica femeii* ("The Woman's Chronicle"), assigned to female journalist Ecaterina Raicoviceanu-Fulmen.[28] Over the following decade, it hosted regular contributions by other militant women, among them Lucrezzia Karnabatt, E. Marghita, Maura Prigor, Laura Vampa and Aida Vrioni.[28] Having endorsed the creation of a journalists' trade union and a Romanian Writers' Society, the newspaper also claimed to have inspired the idea of a Bucharest ambulance service, a project taken up by physician Nicolae Minovici and fulfilled in 1906.[12] Despite his leftist sympathies, Mille found himself in conflict with Romania's labor movement: believing that the Linotype machines would render their jobs obsolete, they went on strike, before the editor himself resolved to educate them all in the new techniques.[6]

Adevărul's ongoing support for Jewish emancipation was accompanied by a sympathetic take on the growing Zionist movement. In 1902, the paper offered an enthusiastic reception to visiting French Zionist Bernard Lazare, prompting negative comments from the antisemitic French observers.[29] By 1906, *Adevărul*'s attitude prompted historian Nicolae Iorga, leader of the antisemitic Democratic Nationalist Party, to accuse the newspaper of cultivating a "Jewish national sentiment" which, he claimed, had for its actual goal the destruction of Romania.[30] In his *Naționalism sau democrație* ("Nationalism or Democracy") series of articles for *Sămănătorul* magazine (an ethno-nationalist organ published by Iorga), the Transylvanian-based thinker Aurel Popovici, who criticized the elites of Austria-Hungary on grounds that they were serving Jewish interests, alleged that the impact of *Adevărul* and *Dimineața* carried the same risk for Romania.[31] In later years, Iorga casually referred to *Adevărul* as "the Jewish press organ", while, together with his political associate A. C. Cuza and other contributors to his *Neamul Românesc* journal, he repeatedly claimed that the entire press was controlled by the Jews.[32] The antisemitic discourse targeting the Sărindar-based publications was taken up in the same period by the traditionalist Transylvanian poet Octavian Goga and by businessman-journalist Stelian Popescu (who, in 1915, became owner of *Universul*).[33]

Pursuing its interest in the peasant question, *Adevărul* was one of the main factors of dissent during the 1907 Peasant Revolt, which was violently quelled by the National Liberal cabinet of Dimitrie Sturdza. The paper reported on or made allegations about the shooting and maltreatment of peasants, reputedly to the point where government officials promised to end repression if Mille agreed to tone down his publication.[8] Various researchers accuse Mille of having seriously exaggerated the scale of repression for political purposes.[23][34][35][36] Historian Anton Caragea, who theorizes the intrusion of Austria-Hungary, argues that, having received payments from Austro-Hungarian spies, both *Adevărul* and *Universul* were conditioned to incite public sentiment against the Sturdza executive.[35] Soon after the revolt, *Editura Adevĕrul* published Caragiale's *1907, din primăvară până în toamnă* ("1907, From Spring to Autumn"), an attack on the Kingdom's institutions and analysis of its failures in connection to the rebellion, which was an instant best-seller.[15][37]

Early 1910s

Following the 1907 events, the gazette participated in an extended anti-monarchy campaign, which also involved *Facla*, a newspaper edited by Mille's son-in-law,[36] the republican and socialist journalist N. D. Cocea, as well as Romanian anarchist milieus.[38] In 1912, it participated in one of Cocea's publicity stunts, during which the *Facla* editor, together with his colleague, poet Tudor Arghezi, simulated their own trial for *lèse majesté*, by reporting the mock procedures and hosting advertisements for *Facla*.[38] Like *Facla* itself, *Adevărul* circulated stereotypical satires of Carol I, constantly referring to him as *neamțul* ("the German" in colloquial terms) or *căpușa* ("the tick").[38]

In 1912, the combined circulation of *Adevărul* and *Dimineața* exceeded 100,000 copies, bringing it a revenue of 1 million lei;[12] the two periodicals assessed that, between January and August 1914, they had printed some 1,284 tons of paper.[39] *Adevărul* had become the highest-grossing, but also the highest-paying press venue, and consequently the most sought-after employer: in 1913, it had a writing and technical staff of 250 people (whose salaries amounted to some 540,000 lei), in addition to whom it employed 60 correspondents and 1,800 official distributors.[12] *Adevărul* reportedly had a notoriously stiff editorial policy, outlined by Mille and applied by his administrative editor Sache Petreanu, whereby it taxed the proofreaders for each typo.[12][14] Mille himself repeatedly urged his employees to keep up with the events, decking the walls with portraits of 19th-century newspaperman Zaharia Carcalechi, infamous for his professional lassitude.[5] In addition to establishing permanent telephone links within Austria-Hungary (in both Vienna and Budapest), *Adevărul* maintained a regular correspondence with various Balkan capitals, and pioneered shorthand in transcribing interviews.[6] Among its indigenous journalists to be sent on special assignment abroad were Emil Fagure and Barbu Brănișteanu, who reported on the 1908 Young Turk Revolution from inside the Ottoman Empire, as well as from the Principality of Bulgaria and the Kingdom of Serbia.[6] The newspaper was nevertheless subject to a practical joke played by its correspondent, future writer Victor Eftimiu: instead of continuing his *Adevărul*-sponsored trip to France, Eftimiu stopped in Vienna, and compiled his "Letters from Paris" column from the press articles he read at Café Arkaden.[40]

Adevărul's coverage of the international scene gave Romanians a window to political and cultural turmoil. By 1908, *Adevărul* was covering the burgeoning European avant-garde, offering mixed reviews to Futurism and deploring the supposed end of literary realism.[41] In late 1910, claiming to speak for "the democratic world", it celebrated the Portuguese republican revolt.[42] The efforts made for establishing and preserving international connections, *Adevărul* claimed, made it one of the first papers in the world to report some other events of continental importance: the 1911 food riots in Vienna, the outbreak of the First Balkan War, and the diplomatic conflict between the Greek and Bulgarian Kingdoms in the run-up to the Second Balkan War.[6] During the latter showdowns, *Adevărul* also employed several literary and political personalities as its correspondents: the paper's future manager Iacob Rosenthal in Sofia, Serbian journalist Pera Taletov in Belgrade, Romanian writer Argentina Monteoru in Istanbul, and Prince Albert Gjika in Cetinje.[6] In July 1913, the newspaper reported extensively on massacres committed by the Hellenic Army in Dojran, Kilkis and other settlements of Macedonia, while discussing the "terror regime" instituted in

Bulgaria by Tsar Ferdinand I.[43] Later the same month, as Romania joined the anti-Bulgarian coalition and her troops entered Southern Dobruja, *Adevărul* gave coverage to the spread of cholera among soldiers, accusing the Conservative executive headed by Titu Maiorescu of hiding its actual toll.[44]

Also at that stage, the newspaper had become known for organizing raffles, which provided winners with expensive prizes, such as real estate and furniture.[12] It was also the first periodical to have established itself in the countryside, a record secured through a special contract with the Romanian Post, whereby postmen acted as press distributors, allowing some 300 press storage rooms to be established nationally.[5][12] Political differences of the period, pitting *Adevărul* editors against National Liberal politicos, threatened this monopoly: under National Liberal cabinets, the Post was prevented from distributing the newspaper, leading it to rely on subscriptions and private distributors.[12] Famous among the latter were Bucharest paperboys, who advertised *Adevărul* with political songs such as the republican anthem *La Marseillaise*.[12]

World War I

After the outbreak of World War I, the newspaper further divided the surviving socialist camp by swinging into the interventionist group, calling for a declaration of war against the Central Powers.[45] This position was more compatible with that of newspapers like *Universul*, *Flacăra*, *Furnica* or *Epoca*, clashing with the socialist press, the Poporanists, and Germanophile gazettes such as *Seara*, *Steagul*, *Minerva* or *Opinia*.[46] According to historian Lucian Boia, this stance was partly explained by the Jewish origin of its panelists, who, as advocates of assimilation, wanted to identify with the Romanian cultural nationalism and irredenta; an exception was the Germanophile Brănișteanu, for a while marginalized within the group.[47]

Bucharest demonstration in favor of Romania's entry into World War I (1915 or 1916).

Adevărul agitated with energy against Austria-Hungary on the Transylvanian issue, while giving less exposure to the problems of Romanians in Russian-held Bessarabia. This was a programmatic choice, outlined by Transylvanian academic Ioan Ursu in a September 1914 article for *Adevărul*, where Russophobia was condemned as a canard.[48] Over the course of 1914, the aging historian A. D. Xenopol also made *Adevărul* the host of his interventionist essays, later collected as a volume.[49] In early winter 1915, *Adevărul* publicized the visit of British scholar Robert William Seton-Watson, who campaigned in favor of the Entente Powers and supported the interventionist Cultural League for the Unity of All Romanians. In his interview with *Adevărul*, Seton-Watson identified the goals of Romanians with those of Serbs and Croats, stressing that their common interest called for the partition of Austria-Hungary, ending what he called "the brutal and artificial domination of the Magyar race".[50] One of the newspaper's own articles, published in April 1916, focused on the ethnic German Transylvanian Saxons and their relationship with Romanians in Austria-Hungary, claiming: "Except for the Hungarians, we had throughout our history, just as we have today, an enemy just as irreducible and who would desire our disappearance just as much: the Saxon people."[51] According to literary historian Dumitru Hîncu, such discourse was replicated by other pro-Entente venues, marking a temporary break with a local tradition of more positive ethnic stereotypes regarding the Germans.[51]

The interventionist campaign peaked in summer 1916, when it became apparent that Ion I. C. Brătianu's National Liberal cabinet was pondering Romania's entry into the conflict on the Entente side (*see Romania during World War I*). Mille himself explained the war as a "corrective" answer to Romania's social problems and a "diversion" for the rebellion-minded peasants.[52] The newspaper, described by American scholar Glenn E. Torrey as "sensationalist", provided enthusiastic accounts of the Russians' Brusilov Offensive, which had stabilized the Eastern Front in Romania's proximity, announcing that the "supreme moment" for Romania's intervention had arrived.[53] This attitude resulted in a clash between *Adevărul* on one side and Romania's new dominant socialist faction, the Social Democratic Party of Romania (PSDR) and the socialist-controlled labor movement on the other. The newspaper reported the official government position on the bloody confrontations between workers and Romanian Army troops in the city of Galați.[54] Using a style Torrey describes as "inflammatory", *Adevărul* also attacked PSDR leader Christian Rakovsky, co-founder of the anti-interventionist and internationalist Zimmerwald Movement, accusing him of being an "adventurer" and hireling of the German Empire.[55] In a 1915 letter to Zimmerwald promoter Leon Trotsky, Rakovsky himself claimed that Mille had been corrupted by Take Ionescu, leader of the pro-Entente Conservative-Democratic Party, and that his newspapers issued propaganda "under the mask of independence".[56]

Romania eventually signed the 1916 Treaty of Bucharest, committing herself to the Entente cause. Its intervention in the war was nevertheless ill-fated, and resulted in the occupation of Bucharest and much of the surrounding regions by the Central Powers, with the Romanian authorities taking refuge in Iași. While Mille himself fled to Iași and later Paris, his newspapers were banned by the German authorities and the Sărindar headquarters became home to the German-language official mouthpiece, *Bukarester Tageblatt*.[5][13][22] Brănișteanu, who did not join in the exodus, worked with Constantin Stere on the Germanophile paper *Lumina*.[57] In early 1919, as the Germans lost the war, Mille returned and both *Adevărul* and *Dimineața* were again in print.[5][13][22] In later years, *Adevărul*'s Constantin Costa-Foru covered in detail and with noted clemency the trials of various "collaborationist" journalists, including some of its former and future contributors (Stere, Tudor Arghezi, Saniel Grossman).[58] The newspaper was by then also reporting about Seton-Watson's disappointment with post-war Greater Romania and the centralist agenda of its founders.[59]

1919 edition

Early interwar years

Once reestablished, *Adevărul* became a dominant newspaper of the interwar period and preserved its formative role for popular culture, being joined in its leftist niche some other widely circulated periodicals (*Cuvântul Liber*, *Rampa* etc.).[60] More serious competition came from its old rival *Universul*, which now surpassed it in popularity at a national level.[61] By 1934, *Adevărul* and *Dimineața* still boasted a combined

Exhibit 19

Evidence towards Dr. Marinescu's leadership role as President of the MIT Postdoctoral Association

1. Statistics about the faculty and research staff at MIT.
2. Newsletter about the MIT postdoc population, and their importance towards groundbreaking research done at MIT.
3. Welcome Letter from Prof. Maria Zuber, MIT VP for Research, on Dr. Wang's initial election as Vice-President of the MIT PDA.
4. Email from XX, MIT PDA advisor, confirming Dr. Wang stepping up to the President role of MIT PDA.
5. Screenshot from MIT PDA website, confirming Dr. Wang as President during 2019-2020 (https://pda.mit.edu/about/previous-pda-officers/).
6. Diploma of appreciation from the MIT VP for Research.
7. Achievements of the MIT PDA, as listed on the MIT PDA website (https://pda.mit.edu/advocacy/achievements/).

Exhibit 20

Evidence towards Dr. Marinescu's leadership role in the organization of TADPOLE Challenge

1. Email from Dr. Wang towards all TADPOLE participants and advisors, regarding the announcement of the competition's final results.
2. Email from Dr. Wang towards all TADPOLE participants and advisors, announcing the submission of the manuscript towards a journal publication.
3. Email from Dr. Wang towards the organisation of a Featured Research Session on TADPOLE Challenge at the Alzheimer's Association International Conference.
4. Screenshot from the oral presentation given by Dr. Wang on the final results of TADPOLE Challenge, at the Alzheimer's Association International Conference. (https://www.youtube.com/watch?v=wYHS9OW-Dv8)
5. First pages of three articles authored by Dr. Wang on the TADPOLE Challenge, confirming his leadership role through first-authorship.

Exhibit 21

Number of citations of top-5 articles in top 100 publications worldwide

Google Scholar

Top publications

Categories English

h5-index is the h-index for articles published in the last 5 complete years. It is the largest number h such that h articles published in 2015-2019 have at least h citations each. hide

	Publication	h5-index	h5-median
1.	Nature	376	552
2.	The New England Journal of Medicine	365	639
3.	Science	356	526
4.	The Lancet	301	493
5.	IEEE/CVF Conference on Computer Vision and Pattern Recognition	299	509
6.	Advanced Materials	273	369
7.	Nature Communications	273	366
8.	Cell	269	417
9.	Chemical Reviews	267	438
10.	Chemical Society reviews	240	368
11.	Journal of the American Chemical Society	236	324
12.	Angewandte Chemie	229	316
13.	Proceedings of the National Academy of Sciences	228	299
14.	JAMA	220	337
15.	Nucleic Acids Research	219	475
16.	Physical Review Letters	209	288
17.	International Conference on Learning Representations	203	359
18.	Journal of Clinical Oncology	202	300
19.	Renewable and Sustainable Energy Reviews	201	263
20.	Energy & Environmental Science	199	289
21.	Neural Information Processing Systems	198	377
22.	ACS Nano	193	257
23.	Nature Materials	184	283
24.	The Lancet Oncology	183	300
25.	Nano Letters	183	241
26.	Advanced Energy Materials	181	250
27.	Nature Genetics	180	266
28.	Scientific Reports	178	226
29.	IEEE/CVF International Conference on Computer Vision	176	295
30.	PLoS ONE	175	237
31.	Nature Medicine	173	288
32.	Advanced Functional Materials	172	221
33.	International Conference on Machine Learning (ICML)	171	309
34.	The Astrophysical Journal	167	231

35.	Circulation	166	260
36.	Journal of the American College of Cardiology	164	232
37.	Journal of Materials Chemistry A	161	216
38.	Nature Nanotechnology	160	272
39.	ACS Applied Materials & Interfaces	160	200
40.	Journal of High Energy Physics	158	209
41.	Nature Biotechnology	154	269
42.	Journal of Cleaner Production	154	208
43.	Neuron	154	199
44.	European Heart Journal	153	245
45.	Applied Catalysis B: Environmental	153	189
46.	Nature Neuroscience	152	219
47.	Nature Methods	151	242
48.	BMJ	150	222
49.	Accounts of Chemical Research	149	220
50.	Gastroenterology	148	222
51.	Physical Review D	148	208
52.	Blood, The Journal of the American Society of Hematology	148	192
53.	Cochrane Database of Systematic Reviews	147	218
54.	Nano Energy	147	192
55.	American Economic Review	146	227
56.	ACS Catalysis	146	207
57.	Monthly Notices of the Royal Astronomical Society	146	193
58.	European Conference on Computer Vision	144	286
59.	Nature Photonics	144	245
60.	Computers in Human Behavior	144	198
61.	Applied Energy	143	185
62.	Science Advances	142	213
63.	Nature Physics	140	217
64.	Chemistry of Materials	140	189
65.	IEEE Communications Surveys & Tutorials	138	248
66.	Environmental Science & Technology	138	185
67.	Nature Reviews. Molecular Cell Biology	137	264
68.	Immunity	137	204
69.	Cell Metabolism	137	191
70.	Nature Climate Change	136	213
71.	Science Translational Medicine	136	202
72.	Meeting of the Association for Computational Linguistics (ACL)	135	220
73.	Chemical engineering journal	134	171
74.	Molecular Cell	133	181
75.	Clinical Cancer Research	133	177
76.	Chemical communications (Cambridge, England)	132	158
77.	IEEE Transactions on Pattern Analysis and Machine Intelligence	131	261

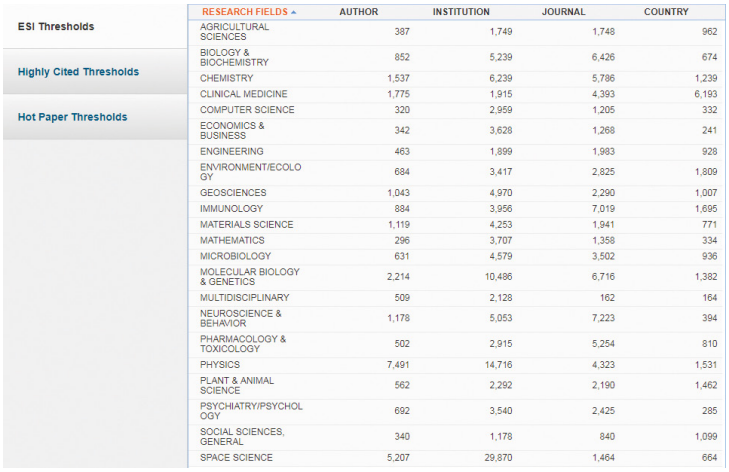
78.	Science of The Total Environment	131	176
79.	Nanoscale	131	169
80.	IEEE Communications Magazine	130	190
81.	Nature Immunology	130	189
82.	Journal of Hepatology	130	188
83.	European Urology	130	187
84.	The Journal of Clinical Investigation	130	179
85.	Nature Energy	129	235
86.	The Lancet Infectious Diseases	129	189
87.	IEEE Transactions on Industrial Electronics	129	174
88.	Cell Reports	128	165
89.	Physical Review B	128	156
90.	Nature Reviews Cancer	127	246
91.	Diabetes Care	127	209
92.	The Journal of Physical Chemistry Letters	127	193
93.	Circulation Research	127	187
94.	Annals of the Rheumatic Diseases	127	183
95.	eLife	127	159
96.	AAAI Conference on Artificial Intelligence	126	183
97.	Bioinformatics	125	207
98.	Annals of Oncology	125	199
99.	Nature Reviews Immunology	124	265
100.	Gut	124	193

Dates and citation counts are estimated and are determined automatically by a computer program.

Exhibit 22

Number of citations of top 1% authors percentile according to the ESI index, by research field.

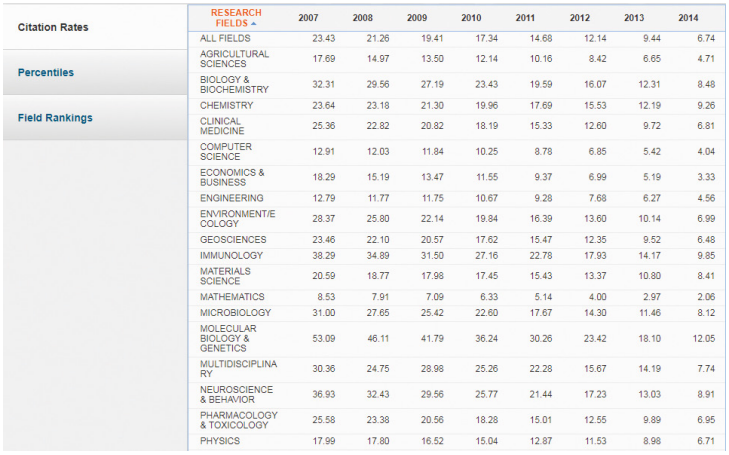
- For Computer Science, having 320 citations as an author classifies one within top 1% of researchers worldwide.



ESI Thresholds
Highly Cited Thresholds
Hot Paper Thresholds

RESEARCH FIELDS	AUTHOR	INSTITUTION	JOURNAL	COUNTRY
AGRICULTURAL SCIENCES	387	1,749	1,748	962
BIOLOGY & BIOCHEMISTRY	852	5,239	6,426	674
CHEMISTRY	1,537	6,239	5,786	1,239
CLINICAL MEDICINE	1,775	1,915	4,393	6,193
COMPUTER SCIENCE	320	2,959	1,205	332
ECONOMICS & BUSINESS	342	3,628	1,268	241
ENGINEERING	463	1,899	1,983	928
ENVIRONMENT/ECOLOGY	684	3,417	2,825	1,809
GEOSCIENCES	1,043	4,970	2,290	1,007
IMMUNOLOGY	884	3,956	7,019	1,695
MATERIALS SCIENCE	1,119	4,253	1,941	771
MATHEMATICS	296	3,707	1,358	334
MICROBIOLOGY	631	4,579	3,502	936
MOLECULAR BIOLOGY & GENETICS	2,214	10,486	6,716	1,382
MULTIDISCIPLINARY	509	2,128	162	164
NEUROSCIENCE & BEHAVIOR	1,178	5,053	7,223	394
PHARMACOLOGY & TOXICOLOGY	502	2,915	5,254	810
PHYSICS	7,491	14,716	4,323	1,531
PLANT & ANIMAL SCIENCE	562	2,292	2,190	1,462
PSYCHIATRY/PSYCHOLOGY	692	3,540	2,425	285
SOCIAL SCIENCES, GENERAL	340	1,178	840	1,099
SPACE SCIENCE	5,207	29,870	1,464	664

Citation Thresholds
View the minimum number of citations required to be ranked as a top author, institution, journal, country, or paper in each of the 22 research fields in Essential Science Indicators



Citation Rates
Percentiles
Field Rankings

RESEARCH FIELDS	2007	2008	2009	2010	2011	2012	2013	2014
ALL FIELDS	23.43	21.26	19.41	17.34	14.68	12.14	9.44	6.74
AGRICULTURAL SCIENCES	17.69	14.97	13.50	12.14	10.16	8.42	6.65	4.71
BIOLOGY & BIOCHEMISTRY	32.31	29.56	27.19	23.43	19.59	16.07	12.31	8.48
CHEMISTRY	23.64	23.18	21.30	19.96	17.69	15.53	12.19	9.26
CLINICAL MEDICINE	25.36	22.82	20.82	18.19	15.33	12.60	9.72	6.81
COMPUTER SCIENCE	12.91	12.03	11.84	10.25	8.78	6.85	5.42	4.04
ECONOMICS & BUSINESS	18.29	15.19	13.47	11.55	9.37	6.99	5.19	3.33
ENGINEERING	12.79	11.77	11.75	10.67	9.28	7.68	6.27	4.56
ENVIRONMENT/ECOLOGY	28.37	25.80	22.14	19.84	16.39	13.60	10.14	6.99
GEOSCIENCES	23.46	22.10	20.57	17.62	15.47	12.35	9.52	6.48
IMMUNOLOGY	38.29	34.89	31.50	27.16	22.78	17.93	14.17	9.85
MATERIALS SCIENCE	20.59	18.77	17.98	17.45	15.43	13.37	10.80	8.41
MATHEMATICS	8.53	7.91	7.09	6.33	5.14	4.00	2.97	2.06
MICROBIOLOGY	31.00	27.65	25.42	22.60	17.67	14.30	11.46	8.12
MOLECULAR BIOLOGY & GENETICS	53.09	46.11	41.79	36.24	30.26	23.42	18.10	12.05
MULTIDISCIPLINARY	30.36	24.75	28.98	25.26	22.28	15.67	14.19	7.74
NEUROSCIENCE & BEHAVIOR	36.93	32.43	29.56	25.77	21.44	17.23	13.03	8.91
PHARMACOLOGY & TOXICOLOGY	25.58	23.38	20.56	18.28	15.01	12.55	9.89	6.95
PHYSICS	17.99	17.80	16.52	15.04	12.87	11.53	8.98	6.71

Field Baselines
Baselines are annualized expected citation rates for papers in a research field. View baselines for Citation Rates, Percentiles, and Field Rankings (see the Glossary section for more info)

Glossary

Citation Rates

Average citation rates are calculated for each year of the 10-year period, based on accumulated citations from the year of publication to the most current bimonthly update. Averages are calculated by adding the citation counts of individual papers and dividing by the number of papers. An average for the full 10-year period is also given in All Years.

Field Rankings

Field Rankings displays total papers, total citations received, citations per paper, and Hot and Highly Cited papers in each field.

Percentiles

The term ”percentile” designates a citation threshold at or above that at which a fixed fraction of the papers fall. This term is used to denote any fixed fraction of top papers ordered by citation count. The levels we have selected for listing by field and year are 0.01%, 0.1%, 1.0%, 10%, 20%, and 50%.

Research Fronts

A group of Highly Cited papers, referred to as “core papers,” in a specialized topic defined by co-citation analysis. Since the assignment of papers to a Research Front is not based on the journal categories used in Essential Science Indicators, Research Fronts offer an alternative classification scheme for Highly Cited papers.

Thresholds required for an entity or paper's inclusion in Essential Science Indicators		
	Citation percentile	Years of data examined
Scientists	1%	10
Institutions	1%	10
Countries	50%	10
Journals	50%	10
Highly Cited Papers	1%	10
Hot Papers	.1%	2

Top papers

- Highly Cited Papers: The top-cited papers over the last 10 years in 22 scientific fields. Rankings are based on meeting a threshold of the top 1% by field and year based on total citations received.
- Hot Papers: Papers published in the past two years that receive enough citations during the most recent bimonthly update to place them in the top 0.1%when compared to peer papers.

Getting help

Click the Help button on any page to get detailed help on features, as well as detailed examples.

Stay informed about Essential Science Indicators at: clarivate.com/products/essential-science-indicators/

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+1 215 386 0100

Latin America
Brazil: +55 11 8370 9845
Other countries: +1 215 823 5674

Europe, Middle East and Africa
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Exhibit 23

Confirmation of PhD degree and Diploma of Dr. Wang issued by University College London, alongside confirmation of MEng degree and transcript of Dr. Wang issued by Imperial College London

Exhibit 24

Offer letter of Dr. Wang in the Computer Science and Artificial Intelligence Laboratory at the Massachusetts Institute of Technology

Exhibit 25

First pages of 6 additional publications authored by Dr. Marinescu

1. **Marinescu, Razvan V.**, et al. "Disease knowledge transfer across neurodegenerative diseases." International Conference on Medical Image Computing and Computer-Assisted Intervention. Springer, Cham, 2019.

2. **Marinescu, Razvan V.**, et al. "BrainPainter: A software for the visualisation of brain structures, biomarkers and associated pathological processes." Multimodal brain image analysis and mathematical foundations of computational anatomy. Springer, Cham, 2019. 112-120.

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