

## STEM CAREERS AND SKILLS OF THE FUTURE

The STEM Alliance proposes a series of online events (webinars and chat discussions) and career sheets that aim to promote Science, Technology, Engineering and Mathematics (STEM) careers with role models. Representatives from companies – partners of the STEM Alliance – are invited to give online and written presentations to inform teachers about possible careers in their companies. The career sheet serves as an awareness-raising tool for teachers and career guidance officers, as well as providing valuable information for the companies' own awareness-raising campaigns.

Please do keep in mind that the information in this career sheet relates closely to the context of the professional whose experience the career profile is based on. STEM professions, studies and challenges vary between countries and industry sectors.

### Research Engineer

#### Name and career title:

Katarzyna Biesialska, Associate Research Engineer at CA Technologies

#### Provide a short overview of your job

*I work in the CA Technologies Strategic Research team in Barcelona, Spain.*

*Our team is focused on the long-horizon research (i.e. over 3 years), which we conduct in various areas of computer science. In my case, I'm doing an industrial PhD in the area of data science and software engineering. I am doing my 3-year doctoral research project and am exploring data-driven mechanisms to improve Agile software development processes in large organizations.*

*In general, in our research team we apply a fast, iterative approach to respond to the rapidly changing environments (i.e. business, technological and scientific). We work with cutting-edge technologies and invent novel methods to solve research problems in our domain. I must admit, it is one of the most inspiring environments in which I have ever worked.*



### What does a typical working day look like?

*The great part of my work is that each day is a bit different. I try to learn new things and develop new skills every day. In my work I'm able to leverage my engineering background as well as my knowledge of organization management.*

*I spend a lot of time reading various scientific publications on empirical research, Agile software development, Machine Learning, or process mining, to name just a few. From time to time I attend courses and seminars to broaden my knowledge in those areas. In a nutshell, it's a continuous learning process.*

*As for my own research, I mainly devote my time to activities such as data collection and data analysis, I also conceive and design studies, carry out experiments as well as write scientific papers for conferences and journals. A lot of these tasks involve computer programming, as data exploration, implementation of devised methods, execution of experiments and development of proof of concept solutions require coding literacy. From time to time I prepare presentations about my projects or what I have learned so far. Industrial research also comprises of navigating organizations where empirical research is conducted, i.e. this includes working with people from different departments.*

*Our team has flexible working hours, but as many of us have a lot of meetings to attend throughout the day we tend to work from 9:00 am to 6:00 pm, just like the rest of the office. I personally have stakeholders in the company as well as at the university. Therefore, I strongly benefit from the collocation opportunity that CA offers (CA has an office at the university where I'm doing my PhD). Hence, I mostly work from our main office and sometimes I go to the university, where I meet with my academic supervisor and colleagues from my university research group.*

### Give an overview of your study path – how did you get into this career?

*I have always been fascinated to understand how things are built and work, so engineering has been a lifelong interest of mine. In the first grade I remember asking my grandmother to buy me a book (although I barely read at that time) which explained how different machines work - - telephone, car engine, laser etc.*

*So, having this natural inclination towards learning the inner-workings of things, I think was key. My grandfather, who was an electric engineer, was a role model to me so this probably also influenced my interests. For example, whenever my father or grandfather were doing some improvements or fixing something at home, or the car or garden, I was always keen to assist them and learn from them. When my parents bought our first computer, I became hooked on designing first websites and the like. As for school subjects, I tried to be well-rounded and with time understand which disciplines I enjoyed learning most. As a result, I felt the urge to focus more on engineering subjects, even though I also very much liked some of the humanities at school.*

*While at school, I somehow always preferred physics over mathematics. It might be that I was very fortunate to have really inspiring physics teachers who were passionate about their discipline and teaching, as opposed to my maths teachers who rather discouraged me in my efforts to understand math and pursue a career in a STEM field.*

*It wasn't until I discovered maths at university level that I understood it and began to enjoy it – and become good at it. Linear algebra, numerical methods and different statistics courses still remain one of my favorite subjects at the university. Fortunately, with physics it was different, I didn't have to wait that long. My confidence in understanding it has never been undermined by anyone with enough credibility to make me doubt my own abilities to comprehend it. My physics teachers in primary and secondary schools encouraged me to take part in the extra-curricular activities such as attending students' research group meetings, the annual Warsaw Science Festival or doing laboratory classes for the first-year university students while being still in high school. Hence, choosing my educational path at university level became relatively easy.*

*Warsaw University of Technology, being one of the best technical universities in Poland, gave me necessary fundamentals to understand computer science in general and strengthen my interest in Machine Learning and data analysis. While I really enjoyed my time at the university, as courses were intellectually stimulating and throughout the years provided me with plenty of opportunities to explore different areas of computer science and electrical engineering, at some point I felt I lacked hands-on experience. Therefore, I started my career as a Data Warehouse/Business Intelligence consultant as I wanted to hone my data analytics skills and learn to design and develop enterprise scale systems.*

*Later on, I complemented my technical background with management studies, allowing me to analyze organizations from different angles and see them as complex systems, which – according to Conway's Law – produces software that reflects its social structures. During my professional career, I have had an opportunity to get exposure to the full end-to-end IT project lifecycle from the implementation as well as the coordination perspective.*

*With increasing availability of data, I believe organizations are able to make more informed decisions related to software development management using Machine Learning and Artificial Intelligence methods. As such, I decided to pursue a PhD in computer science with a strong industrial component at the Universitat Politècnica de Catalunya (UPC) in Barcelona.*

### **What are the key skills needed to do your job?**

*I would consider creativity and curiosity to be one of the most important qualities one needs to possess in order to succeed in my role. This is because one needs to be a constant learner and come up with innovative ideas to tackle non-trivial problems.*

*Also, critical thinking plays an important role in any researcher's skill set. The ability to find flaws in a line of reasoning and ask proper questions is key to making scientific progress.*

*Research rigor is equally important. A scientist must be diligent and systematic to ensure that the conducted study is methodically sound. Of course, having good computer science fundamentals and computer programming skills is a prerequisite for a similar job to mine.*

*I would also not underestimate the importance of learning academic writing (especially in English) and honing presentation skills. Clear articulation of thoughts is almost as important as the conceived concepts one wants to communicate.*

*Moreover, just like in everyday life, communication, negotiation and general inter-personal skills are highly valuable and help to succeed in every business environment, including industrial research.*

### **With your skills, what types of jobs and industry sectors can you work in?**

*Although research scientist roles, and computer science related jobs in general, are the natural fit for someone with my background and skill set, the broad spectrum of skills mentioned above should give good career prospects in various other roles, ranging from technical entrepreneurial roles in startups, business roles in IT corporations, quantitative research in hedge funds or investment banks to management consulting and venture capital roles.*

### **What are the main challenges in your job?**

*Information technology and computer science are highly applied disciplines. Therefore, making sure that conducted research is industry relevant, i.e. business sees a clear value in it, is one of the biggest challenges in my job. Moreover, ensuring that research performed in the industrial setting is rigorous and scientifically sound is also a non-trivial task. In addition, keeping up with the latest developments in the research domain -- especially in Artificial Intelligence and Machine Learning fields -- has become very challenging nowadays, as more and more scientific papers are published every day. Therefore, information selection is one of the most important skills that every research scientist must develop.*

### **This is a job for you, if...**

*If you apply logical and methodological ways of thinking to problems that you want to solve. If you are not afraid of experimenting with different approaches, embracing the unknown, have a curious mind, learn fast and have courage to question the status quo and challenge long-held beliefs, then you are a destined to be a scientist. To some degree every scientist is a contrarian.*

### **What is your advice to teachers?**

*To start with, I will reverse the question and instead I would give advice to myself as a teenager. First, don't be afraid to ask questions and admit that you don't understand something. Second, if something matters to you, never give up no matter how difficult it may be sometimes or how many times you fail along the way. Mistakes are part of the learning process, they are inevitable, and failure is never final. Third, stick to your values and convictions, don't let anyone stop you from achieving your goals as you can be whatever you want to be as long as you work hard towards your goal and you're passionate about it.*

*Having said that, teachers can greatly help young people by motivating them to discover their passions and unleashing their potential. For instance, they should encourage students to ask*

*questions, to be adventurous when solving problems. I perceive the role of a teacher as motivating and stimulating students to explore different solutions to a problem (not to just rely on what can be found in the textbooks). In the modern world, having a beginner's mind is very important.*

*Our worst enemy in the learning process is our personal uncertainty – this limits our potential. It is not unusual to be afraid if we cannot live up to our parents' expectations. Also, each of us sometimes falls into the trap of comparing ourselves to others (in classrooms it can be especially apparent). All these factors often make us feel insecure, increase anxiety, and in the end paralyze and prevent us from improvement.*

*So, in my opinion it's important that teachers understand students may experience self-doubt and, therefore, should help them fight it. To illustrate my point, I will refer to an excellent talk delivered by Benjamin Zander, conductor of the Boston Philharmonic Orchestra as well as a teacher himself -- "Work (How to give an A)" (the video can be watched here: <https://youtu.be/qTKEBygQic0>).*

*Young people should also develop critical reasoning and improve their decision-making skills by understanding how to avoid cognitive biases. In the age of "fake news" and increasing influence of social media it is extremely important to understand how our brain works and processes information. A Nobel Prize laureate in Economics Daniel Kahneman in his best-selling book "Thinking, Fast and Slow" (which by the way I highly recommend) discusses how people think, and what techniques we can use to avoid pitfalls when making decisions in our everyday lives. He shows that slow thinking may prevent us from immediately jumping to conclusions when we don't have enough evidence to support our claims.*

*Moreover, the author also sheds light on his research process and how he achieved so much in his professional life. As Kahneman says "it is much easier to strive for perfection when you are never bored". And I think this is an essence of what differentiates mediocre from the best in any field; the latter find passion in what they do and eventually excel at it. Hence, passion is the key element that can push us to go out of our comfort zone and improve.*

#### Learn more:

- Katarzyna Biesialska, Associate Research Engineer, CA Technologies, Strategic Research
- <https://twitter.com/kasiabiesialska>
- For anyone interested in STEM (especially computer science) I would recommend a keynote given by Margaret Hamilton at ICSE 2018 (the most important scientific conference in Software Engineering). Margaret Hamilton is the person behind the on-board flight software that brought Apollo 11 to the moon. Her talk is very inspirational and shows how many obstacles she and her team had to overcome in order to finally succeed: <https://www.youtube.com/watch?v=ZbVOF0Uk5IU>