CERN Spring Campus

Filipe Guerreiro

Learning Report

Abstract—The enrollment in this course required the participation in an activity with the goal of helping students complement their usual studies.
In this report, I hope to show what I learned during my activity.
During the course of 3 days, I attended lectures ranging from physics, to job-seeking practices to Bitcoin (and Computer Science of course).I also got a chance to speak and interact with many engineers and physicists at CERN.
At the end of all this, I gained valuable insight into some of the most interesting problems of today, the technologies that are in use in some of the biggest organizations in the world, a lot of job-seeking and working tips, and other interesting tidbits.

Index Terms—CERN, LHC, Physics, IT, Technology, Lecture, Job.

Mostly Technical, short on SOFT-SKILLS!

1 Introduction

With this report, I intend to elaborate on what I learned for the **Portfólio Pessoal IV**, and share the experiences I had while attending the **CERN Spring Campus**. This activity involved attending over 25 hours of lectures, the opportunity to speak with some of the people hosting the event, and an optional Artifical Intelligence (AI) coding challenge against the other attendees.
As I write this, after concluding my activity, I hope to have become more capable and at ease in any kind of environment, be they related to working (in Information Systems) or not.
Over the next few pages, I intend to share with you what I found to be the most interesting and important topics covered, which unfortunately forced me to leave out other themes, such as Language Oriented Programming (LOP), Javascript, Web Application Security and even Bitcoin, that were very eye-opening and refreshing.

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2 Employment skills

2.1 Job seeking

Another of the most useful and entertaining lectures was definitely this one, where we got to hear about the essential techniques each candidate must possess when seeking employment.
The lecture started by going into general market unemployment statistics and compared it with the talent shortages in engineering. However, people still have trouble filling these spots, and so we spent the rest of the talk going into the ways to market and sell your skills more effectively.
To start, creating a positive online presence is imperative. Social media profiles have become an extension of the Curriculum Vitae (CV), and they can be used to hurt your chances if not properly regulated and maintained. Sites like *LinkedIn* should take priority as they have high visibility in Google searches, and sites like *Facebook* need to have careful privacy settings so that compromising photos aren't limited.
When looking for a job, it is important to look not only at the required skills - through the company's own website or through the various job boards, but also to seek jobs that let you develop your professional network, that have values that you can identify to, and

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(0.8) Very Good	CONTEXT x2	SKILLS x1	REFLECT x4	S+C x1	SCORE	Structure x0.25	Ortogr. x0.25	Gramm. x0,.25	Format x0.25	Title x0.5	Filename x0.5	SCORE
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(0.4) Fair	0.6	0.6	0.8	0.8+0.8		1.0	1.0	0.8	0.2	1.0	0.8	
(0.2) Weak												

good managers that can push you and let you grow. Most of this information can be found online through sites like *LinkedIn*, *Glassdoor* or contacting people directly.
Next, we took a look at how to improve the CV, by tailoring the application to the job, putting the relevant skills and most important information at the top, and in bullet-points so they're easier to read, as well as some more in-depth tips.
To wrap it up, I learned the essential tips for surviving an interview, how to prepare for the technical and behavioral questions, and to *always* follow-up an interview.

2.2 Soft-skills for IT workers

After landing a job, it is very likely that one will be working in a team, and as such, it is important to avoid a few common faux pas when starting out.
Not surprisingly, one of the most important skills a programmer needs to have is to know how to work in a team, since any project undertaken will involve months of work and many complexities.
Even in the workplace, it is fundamental to still keep a learning and teaching mentality, since it is one of the best ways to foster relationships and team spirit.
One of the most sought after qualities in an engineer, is the ability to handle people. It is the most used skill in our lives, so it is dedicate time and effort to improve.
There are three simple advices to handle people:
Number one, you can't win an argument. Whether you are right and the other person is wrong, or vice versa, one of the parties always ends up with a hurt pride, but still keeping the same opinion. Number two, don't criticize. This one seemed obvious to me, but indeed, it is always best to look from the other person's point of view so as to make them defensive and hurt their sense of importance. Number three, if you are wrong, admit it. It takes away any attack the other person could have, and you get a lot more than you expected.
I also learned a few techniques to be more productive, like the *Pomodoro* technique, and the evils of multi-tasking.

3 PHYSICS

One of the highlights of the event was definitely the lectures on the physics surrounding the Large Hadron Collider (LHC).
We started by going into the importance of the **Higgs Boson** by first explaining the components of the *Standard Model*, from the *Fermions* - the matter constituents, to the *Bosons* - the Force carriers (electromagnetism, strong and weak interactions).
However, the *Standard Model* doesn't explain how those particles gain mass! From the 1960s, it was thought to exist a field that gave these particles mass, but it was only recently with the construction of the LHC that some evidence of this was found.
From there, we went into the workings of the LHC.
Essentially, the LHC works by creating two high-energy beams at near speed of light (0.999991c - they stressed this four times, I counted) and then colliding them at precise points - at the A Toroidal LHC ApparatuS (ATLAS), A Large Ion Collider Experiment (ALICE), LHC beauty (LHCb) and Compact Muon Solenoid (CMS) detectors which then measure the produced particles' traces.
The detectors measure the path the particles take using *trackers* and the energy they radiate using *calorimeter*s, together with complex algorithms to remove electronics noise and reconstruct the tracks.
However, to produce a Higgs Boson, it takes on average 10 billion proton collisions. With a beam crossing rate of 40 MHz and 1MB per event we have a whopping 40TB of storage every second if we wanted to store everything. So, it is important to keep only what is interesting, only the collision moments.
Thus, we spent the rest of the lecture looking at how the trigger for event capture works, but it was unfortunately too complex for me to grasp, even after revision. In general terms, we looked at the layers, algorithms and custom hardware of the trigger mechanism.
In the concluding moments, we looked at the upgrades currently in store for the LHC, from

the tracker and the trigger to the software which will allow for a much higher degree of collisions AND collision detection, leading to more, overall, happy scientists.

4 Big Data

As I've learned, the LHC produces enormous amounts of information. As such, there needs to be an infrastructure in place to handle the processing and storage of all of it.
Storage in the LHC experiment is distributed across several data centers and across several layers.
Because resources are not infinite, different storage types must be taken advantage of, in order to maximize performance while taking into account the cost. For example, at layer 0 - the layer most close to the LHC experiment, data storage needs to be fast and reliable (and expensive) for handling the high throughput analysis, while in the next layer, data is used for storage, so it must be low-cost and highly reliable (and performance is not necessary); and finally, at the lowest layer we have the users (at thousands of nodes) that require data for analysis, so the storage must be performant and low cost (reliability can be sacrificed - derived data can be recalculated).
For instance, at the tier 1 layer, one of the things that surprised me the most was that the storage option chosen was actually *tapes*! They are much more reliable than hard-disks, don't require power to maintain and have incredibly slow access time - which is actually a benefit if someone would attempt to delete PetaByte (PB)s of information.
Next, we discussed several different kinds of reliability options, another important consideration in data centers. We discussed a few different Redundant Array of Independent Disks (RAID) type options and error correction algorithms and mechanisms that was a very good refresher on what was taught to me at Instituto Superior Técnico (IST).

5 Cloud Computing

One of the last things I'm going to write about follows up nicely from Big Data.
Cloud Computing - the delivery of on-demand computer resources over the Internet on a pay-for-use basis. There are three models of Cloud: Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS).
SaaS is designed for end-users, providing applications on the Cloud which is easily accessible but the user is not able to manage or control the underlying infrastructure. Examples of this are GMail, Google Docs and Microsoft Office 365.
PaaS is designed for application developers, delivering an integrated platform to build and deploy custom applications, enabling users to have control over the deployed applications and possibly configuration settings. Examples of this type of service are Google App Engine, heroku and PANTHEON.
Finally, IaaS provides fundamental computer resources to the user, enabling control of Operating System (OS), storage and deployed applications. Examples are amazon web services, Microsoft Azure and rackspace.
The fundamental technology that managed to enable all of this is **Virtualization**, which unties software from a specific physical machine. Virtual machines are used as a standard deployment object in Cloud Computing; are consolidated into a single server, allowing to reduce idle time and save power, space and cooling.
There are 3 deployment models as well: Private Cloud, Hybrid Cloud and Public Cloud.
In the Private Cloud, the infrastructure is owned and used by a single organization and allows for improving data center efficiency while reducing operational expenses. There are a few technologies to deploy Private Clouds, such as OpenStack (CERN uses a modified version of this), Apache Cloudstack and VMware vCloud suite.
The Public Cloud is owned by a single company but made available to many users. Customers can rent access to it on a pay-as-you-go basis. Main advantage is you don't

have to pay for up-front costs and is quite scalable to the business needs (resources are allocated and deallocated as needed). Amazon, Google and Microsoft all currently have a stake in this market.
The Hybrid Cloud, as could be expected, is a system in which the company has part of the resources in-house while others, less-critical ones are housed externally.
Cloud Computing has many advantages such as a reduced cost by not paying for the cost of infrastructure and pay-as-you-use-it billing model suited to the business, but has a few disadvantages to keep in mind such as a constant Internet connection requirement, unknown data location and control and privacy.

6 Conclusion

During these three days I have attended over 25 hours of lectures, and I've highlighted in this report what I found to be the most interesting and eye-opening subjects to me. I feel that I have learned a great deal over these past days, even more so when I have taken the liberty to reflect and write about it in this report.
Having the chance to learn and speak with some of the smartest and knowledgeable people was a great opportunity and one that I don't think I'll ever forget.
I come away from this experience, hopefully, a more learned and capable man than when I started, and I hope that this is only the first step in a long journey of learning and fulfillment.

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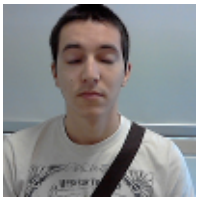

Filipe Miguel Guerreiro Here I am. I am pursuing my Engineering studies at IST.

APPENDIX
STATEMENTS OF EXECUTION

CERN SPRING CAMPUS DIPLOMA

This certifies that

Filipe GUERREIRO

has completed the course of study during the 2015 CERN Spring Campus.
The program consists of 25 hours of lectures held over 3 days.

CERN

TÉCNICO LISBOA

The 2015 CERN Spring Campus was jointly organized by the European Organization for Nuclear Research (CERN), Geneva, Switzerland and The Instituto Superior Técnico, Lisbon, Portugal.

Derek Mathieson

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Director, CERN Spring Campus
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