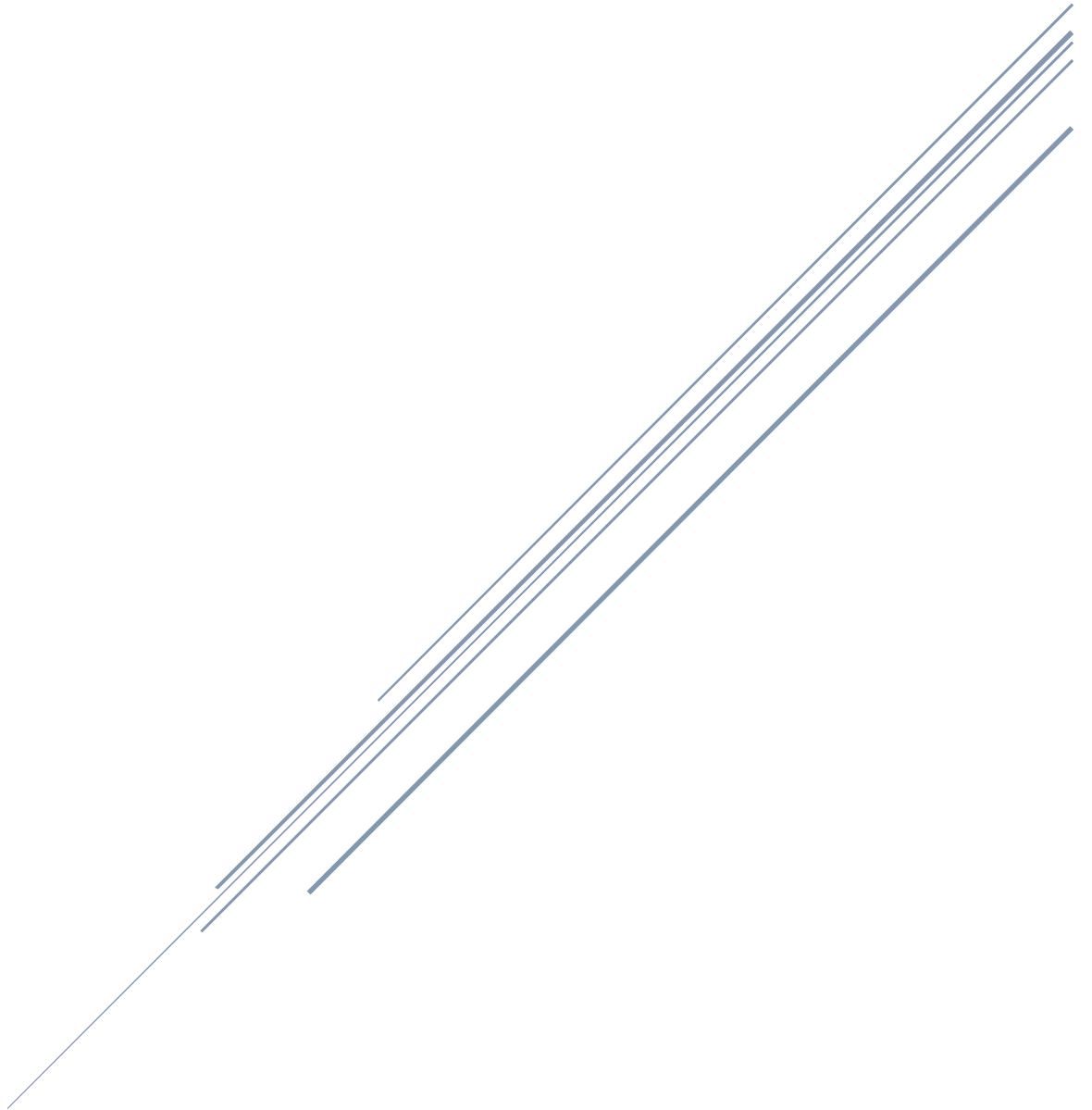


# COMPUTER SCIENCE CAREERS

A Look at Three Career Paths



Luke Duggan  
CPSC 311

## My Report

Luke Duggan  
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Dear Mr. Cooper

I am pleased to transmit this report *Computer Science Careers: A Look at Three Career Paths*. Within this report is information on three computer science careers. The purpose of it is for computer science students to find themselves an area of interest within computer science.

This report goes into detail on these careers and provides information that helped me find a new area of interest as well. I plan to do more research for myself in this area and take electives that will teach me more. I hope many others can benefit from the information contained in the following pages.

Regards,

Luke Duggan

A handwritten signature in black ink that reads "Luke Duggan". The script is cursive and fluid, with the first letters of "Luke" and "Duggan" being capitalized and prominent.

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## Before the Reader Begins

This report covers what I believe are the three most important careers in the computer science field. There are several other careers such as web developers, mobile developers, database administrators, machine learning engineers and many other careers. It's important to note that careers listed in this report may have the same job titles as other careers in the computer science field. The ones covered here are more specific. For example, one career I cover is software engineer, however software engineer is an ambiguous title. I'm particularly focusing on non-web application development in this report. While reading this report, its important to keep in mind that these are not the only three careers in computer science.

For each of these careers, I am expecting a prerequisite of a Bachelor of Science (BS) in Computer Science. It is certainly possible to fulfill any of these positions without one as in the end, experience trumps anything else on a resume. When it comes to someone with little to no experience, obtaining the lowest level position can come with more ease if one has a degree. With a computer science degree, one proves that they were able to pass 4+ years of computer science classes, therefore they can learn what the job entails as they work the job.

## Project Overview

Within this project, I briefly cover the job duties of each level within the given career. Towards the end of each career level, I give the salary for that position as well. Each of the three careers that I cover are Software Engineer, IT Professional, and Data Scientist. The purpose of listing each level within these careers is to show the progression of responsibilities and to give an idea of the direction one would be heading if they follow the career ladder that I've given. At the end of each career section, there is a conclusion about the career and a quick summary of the information in the paragraph.

This report is broken down into three major parts each covering a different career. Each part is broken down like this:

- Career Title
  - Career Ladder Introduction
    - Career Level 1
    - Career Level 2
    - Career Level 3
    - Career Level 4
  - Career Conclusion

After this, I conclude the report by going into an overall review of each career and give my personal recommendation:

- Career Recommendation and Review

## Report Purpose

The main idea I want the reader to get out of this is to help with identifying which direction they want to take their computer science career. This field is so dynamic and quickly changing that I feel its hard to really pinpoint a single area of interest as there are many areas that could interest a college student. It is my hope that by reading my take and the information I gave about these careers, that the reader can at least get an idea of a career that interests them.

## Executive Summary

There are three main career paths within the computer science field:

- Software Engineering
- IT Professional
- Data Scientist

Software engineering is a good career all around. This is because it pays well for each position on the career path and initially doesn't have demanding skill requirements. It also requires a reasonable amount of knowledge in programming languages and application life cycle, but nothing too extreme compared to the different software and tools data scientists use.

In the IT professional path, it doesn't take much to get started and requires a lesser skill set than used by data scientists or software engineers. Having a strong foundation in technological skills is generally the minimum requirement. The pay doesn't climb as rapidly but can reach high levels once the top of the ladder comes into sight.

Finally, in data science, it generally takes a higher education to get into the higher tiers of the field but has much better salaries. For the most part, being proficient in a scripting language like Python and a data visualization tool is enough to get started.

In the flow chart to the right, there's a quick idea of how someone would climb up the ladder in their career path. Each one starts as a low level or junior position and gradually climbs into more important roles. The end game for some people who are climbing the ranks is to seek out a manager position. These positions pay the most and require someone who is knowledgeable in that field to be able to properly oversee activities. On the other hand, some seek to simply be in a higher and more respected position that has similar responsibilities but has the respect of a "senior". These are the people who are well versed in their career field and have many years of experience. They can prove they truly know what they are talking about and have the answers to most of the questions. They may not be the leaders, but they provide good ideas and help steer the team.

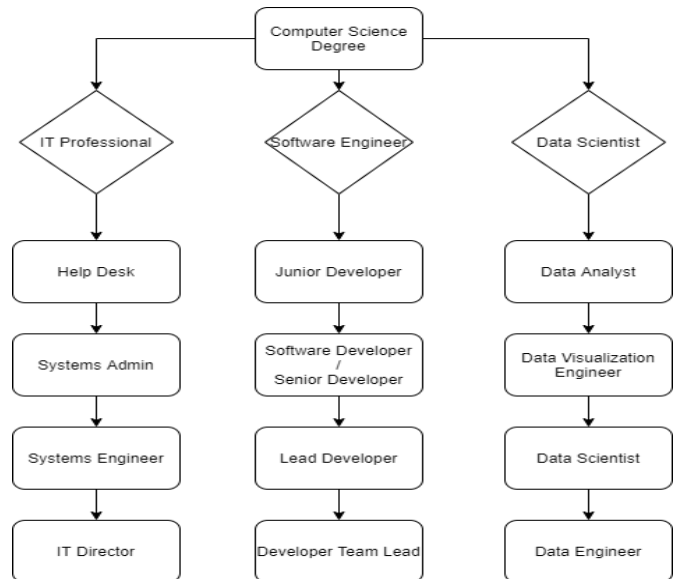


Figure 1: Computer Science Career Flow Chart

From my research of each of these careers, I've come to conclude that data science is the best career to get into. I based this off several factors such as job demand, salary and difficulty. Although I did mention previously that data science is more difficult because it may require an education beyond a bachelor's degree, obtaining a master's degree is not as challenging as it once was. Nowadays, many schools provide the choice of obtaining a master's degree online, removing the need to spend time going to class on campus. Data science is also one of the most highly demanded careers in the computer science field, so there will be no shortage of jobs for anyone looking to enter this career. Finally, data scientists have the highest salaries out of the three careers that I mentioned. Overall, it's a very safe and well-paying career choice and I would recommend it to anyone obtaining a BS in Computer Science.

## Software Engineer

Software engineering is a very broad term that covers a variety of angles within the realm of Computer Science careers. Although there are several different “Software Engineering” positions, the one that will be focused on in this section of the report will be on non-web applications. Application software engineering is a safe and in demand career that could set someone up with a solid job. It’s also projected to have a large increase in employment in the next 8 years according to figure 2.

A good example of a desirable and dynamic software engineer in a language like C++ is constantly keeping up to date with new releases of C++ and learning the useful methods that are released with it. Every couple of years, there is a new update for the standard in C++ software development. If software engineers are not keeping up with these standard changes, then their code and methods will fall behind. It’s important to note that some popular non-web programming languages are updated on a reoccurring basis and new methods and standards become the norm for coding practices.

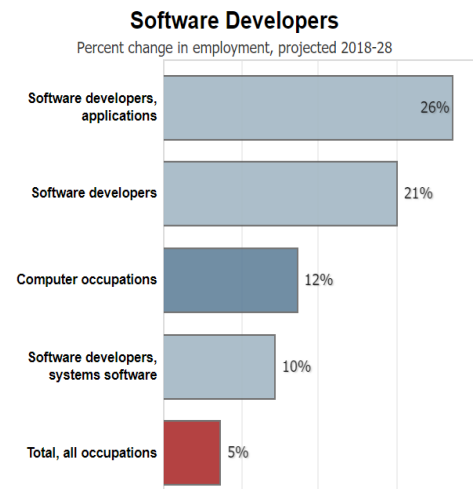


Figure 2: Software Development Job Growth Statistics [1]

### Career Ladder

The route most software engineers take is straight forward no matter what kind of development someone is doing. Even web-based and mobile applications developers all follow similar paths as application software engineers. For the most part, they will start as a low-level developer and make their way up as their skills advance and they learn the ins and outs of the development process <sup>[2]</sup>. For some, the goal is to reach a management position and use their skills to oversee projects and make sure everything runs smoothly. For others they are happy to continue as a senior or lead developer for their projects and continue to code.

### Junior Developer/Intern

It’s very rare for a software engineer to not start their journey as an intern or a junior developer unless they have good connections in a company. This position won’t require too much knowledge except for knowing how to use some fundamental frameworks or libraries, different IDE’s as well as an understanding of the application lifecycle. This is the position where one can make or break their career with a company so it’s important to excel here and show that they are a good candidate for long term employment. The average salary of an entry level software engineer is around \$60,574 <sup>[3]</sup>.

### Software Developer/Senior Developer

This role is the one a software engineer fills once they’ve really shown they are a competitive and well-rounded programmer. Sometimes it’s necessary to hop to another company in order to gain this new job title, however companies are always looking to hire on interns and junior developers as a full-time employee if they are already not full time. The typical requirements for this kind of position require someone who enjoys writing code and has several years of programming experience under their belt <sup>[2]</sup> and has a solid grasp of the app development life cycle. They are also capable of creating entire applications on their own. The average salary of a software developer is \$84,999 <sup>[4]</sup> and for a senior developer its \$103,475<sup>[5]</sup>.

### Lead Developer

The lead developer position requires someone who has a solid background with software engineering and are looking to coordinate teams while also doing the developing or coding at the same time. They are also able to design complex systems that will be implemented by the software developers which makes this an important role as they layout the

steps and planning for creating an application. This position is a great steppingstone into the management level of software engineering. The average salary for this role is \$116,502<sup>[6]</sup>.

#### Developer Team Lead/Software Development Manager

If seeking a management position within software engineering, this is the position to fulfill. This role main purpose is to manage projects and teams of developers and keeps track of the progress of current development. Not only do they oversee the work of an ongoing project, they also bring on and fire developers to make sure development is on track and good progress is being made. According to [payscale.com](https://www.payscale.com), the average salary for this role is \$123,380<sup>[7]</sup>.

#### Conclusion

Non-web-based application software engineering is a highly demanded career especially in cities or areas that are centers of a tech boom. Software engineering is one of the highest demands and fastest growing occupational fields in the United States <sup>[8]</sup>. Starting as a junior developer is a very good steppingstone for anyone who is interested in programming as a non-web-based software engineer. This career path has a solid foundation and can lead to prestigious roles with high salaries.



## IT Professional

Information Technology (IT) is one of the most diverse career terms in computer science. For the most part, IT positions are heavily involved in core computer and network maintenance. The low levels of IT deal with low level projects such as setting up computers in corporate environments, submitting tickets to give access to employees for software, and hardware maintenance. When progressing through an IT career, one takes on heavier responsibilities such as accessing systems and accessing their vulnerabilities or setting up and maintaining networks from hackers. Each position generally has levels to it e.g. going from level 1 to level 3 where each level has more responsibilities.

### Career Ladder

There's no doubt that IT is a less grueling and mind-bending career than software engineering. The career path one will take is rather straightforward but does have some deviations. It starts out as a very mellow and easy-going career which requires basic computer and technological knowledge. As one climbs the ladder, IT professionals are needed in all sorts of nooks and crannies within a business. However, the most essential area they are in high demand in is overseeing a business's systems. Proper set up and maintenance to satisfy the technological needs of a company requires knowledgeable and hardworking systems engineers and administrators.

### Help Desk

Help desk is a great position for someone looking to start a career as an IT professional. It doesn't take much to fulfill a level 1 help desk position and generally requires someone with a moderate amount of tech experience. Here one can learn the responsibilities and general courses of action in technical work environments such as setting up computers to be business ready, installing enterprise software and resolving hardware issues. Some people end up staying in help desk for most of their IT career and elevate the level of help desk they do. Help desk consists of other responsibilities as well. Instead of solely resolving basic software issues and setting up computers, the help desk path continues with tasks like authorizing employees to have access to business systems and doing remote help desk services via remote connection. The average starting salary for a level 1 help desk position is \$40,371<sup>[9]</sup> but someone who makes their way up to level three will be averaging a salary of \$59,000<sup>[10]</sup>.

### Systems Administrator

If looking to truly climb the IT ladder, then leaving the help desk position to a more prestigious position like sys admin (system administrator) is the way to go. This is where one truly manages the systems within a business instead of doing low level projects like in the previous position. It's a level up since a sys admin's main role is to set up and maintain computer systems with responsibilities such as installing and maintaining computer operating systems, web servers, email, and business applications. Most importantly, they ensure that computers in the company's network such as servers, are running smoothly and securely<sup>[11]</sup>. If a sys admin isn't on top of maintaining these networks and systems, they could fall apart. It's very important for them to keep up with new developments and changes within the tech industry as needs within the company could change frequently. The average salary for a Systems Administrator is \$61,935<sup>[12]</sup>.

### Systems Engineer

What makes the systems engineer role so interesting is that they are the ones who design the systems the administrators are maintaining. It's good for a sys admin to fulfill this position as they know the ins and outs of a business's technological structure already. Those who fill this role are implementing the best practices for data and security backups, monitoring the systems used by the businesses network, overseeing installation of networking and computing infrastructures as well as choosing the best solutions out of the wide range of available technologies they can choose from<sup>[13]</sup>. Overall, their main role is to design and set up the businesses network and system architecture that will best suit the needs of the business. The average salary for a Systems Engineer is \$77,768<sup>[14]</sup>.

## IT Director

No matter where a career starts in the IT area, one will ultimately make their way up to a senior IT position. The senior IT position that is the end of the walk for some, is the IT director position. The responsibilities of this position, such as overseeing IT projects and infrastructure, require a solid amount of experience within the IT field. Understanding the process of setting up and maintaining networks, system architecture and implementation of technologies is essential to minimize business challenges. As being the director of IT at a business requires years of wisdom as an IT professional, the average salary is \$122,338<sup>[15]</sup>.

## Conclusion

The IT field is a very promising area for anyone with technological skills looking to further advance them. The barrier of entry for this career path is lower than that in terms of knowledge and skills compared to software engineering therefore getting into IT is not a difficult challenge. Starting in IT with a help desk position requires minimal knowledge in IT. It's not needed as a necessity to have a bachelor's in computer science, but it makes a more desirable candidate. Having a degree shows that one has the potential to be a skilled worker.

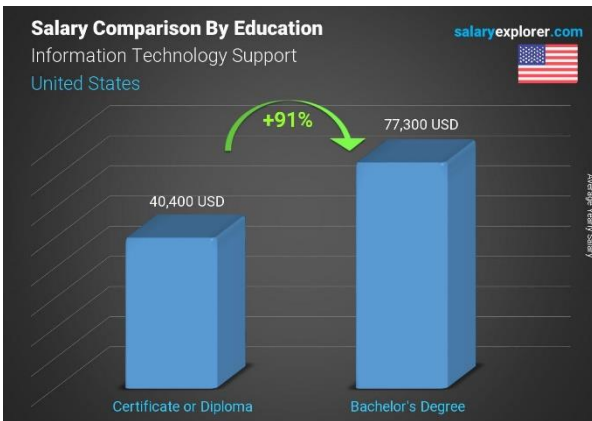


Figure 3: Salary Comparison by Education [16]

IT requires one to be a quick learner and have malleable computer skills that can adjust to the processes and environment of a business's technological infrastructure. The core responsibility of an IT professional is to support or design computer systems within a business. Technology is always changing so it's essential to keep up to date with the software solutions a business uses. IT is an ever-growing area to get into and as more businesses pop up, the demand for IT workers will increase to keep their systems and networks in check.

## Data Scientist

For someone who is in the computer science field and has a taste for mathematics, data science is a great route to take. The typical data scientist fulfills the role of someone who collects a businesses data and visualizes it for a company to optimize or improve business operations. In the age of technology, data is the new gold and being able to view and analyze collected business data is essential to make optimal business adjustments.

### Career Ladder

The climb up the data scientist ladder can start at many places. Ultimately, it's important for anyone looking to get into this field to be experienced with scripting and visualization tools as these tools are going to be used for the rest of the career path. The first two levels as a data scientist focus more on making the data understandable for those who use it to make business decisions. At the last two rungs, it becomes more about collecting data and creating predictions from noticeable trends so the future of the business can be better understood from the analysis.

### Data Analyst

Starting as a data analyst is a solid starting point as the purpose of this position is to sift through data, provide reports and visualizations into the insights of the data. Therefore, starting as a data analyst not only gives a good work experience, but they have very similar responsibilities as a data scientist. Most of their work revolves around statistical modeling which consists of using an organization's data to help make more informed decisions <sup>[17]</sup>. It's very important for data analysts to be familiar with database languages such as SQL or Python. Other software like excel is used for keeping data organized on a spreadsheet, and tools like Tableau or Qlik allow for data visualization. The average salary for a data analyst is \$62,453 <sup>[18]</sup>.

### Data Visualization Engineer

This role comes with similar responsibilities as a data analyst but focuses on the importance of visualization of the data. One of the many tasks a data visualizer does is to spot patterns, trends and correlations. Through this, they can recommend improvements to the aspect of the business they are analyzing such as finance, consumer desirability and hardware costs. There are some businesses that have these engineers work with their software engineers to build products that will be successful for them to market out. As a position driven by big data and analytics, it's important to be well versed in communicating product development decisions. The average salary for a data visualization analyst is \$82,359 <sup>[19]</sup>.

### Data Scientist

For most people making their way up the data career ladder, the data scientist role is the top. This roles core responsibility is collecting data about the company being analyzed. Sometimes companies expect data scientists to be highly educated with a masters or doctoral in computer sciences. Their key duties when working for a company are collecting, analyzing, and interpreting large and complex datasets by using machine learning and predictive analysis <sup>[20]</sup>. As a data scientist, one would use machine learning to assist them which can find patterns and make unbiased and precise predictions. Writing powerful machine learning algorithms in Python for data collection and analysis is what makes this role stand above its predecessors. The average salary for a data scientist is \$120,931 <sup>[20]</sup>.

### Data Engineer

This role isn't necessarily about collecting big data and analyzing it like its predecessors, but instead focuses on creating the structures like databases and processing systems used for data collection. Data engineers are the ones who develop the ecosystem within a business so its systems can communicate with each other to collect and combine data <sup>[20]</sup>. What makes a good data engineer is someone who has experience in the fields of data analysis and collection so they can truly understand what a good infrastructure requires. Being experienced in NoSQL technologies like Apache, a web server software, is a must for making the infrastructures. The average salary of a data engineer is \$151,307 <sup>[20]</sup>.

## Conclusion

Getting into the data side of computer science is a very promising area to get into. More than ever, companies are looking to hire specialists who can extract data and turn it into valuable information that can be used for optimization such as product improvement or development. The career path starts with modeling the data so that it be used for business decisions by higher ups. Then, as one climbs up, they proceed to focus on visualizing the data and assist with building visualizing software. Finally, at the top of the chain, there are the data scientists and engineers. Data scientists

are using algorithms to interpret the data they are pulling in, and engineers are creating the systems they retrieve the data from.

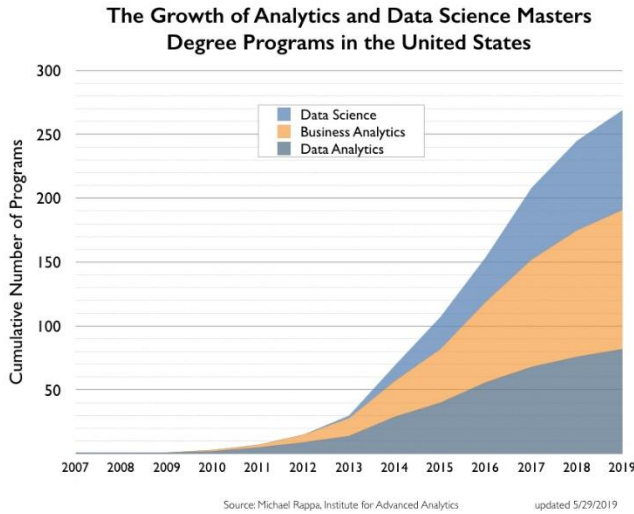


Figure 4: Growth of Analytics and Data Science Master's Degree Programs in the United States [21]

All in all, going into the data field is a safe and reliable choice due to the importance of optimizing businesses operations. They also bring the capability of forecasting future trends of a business which is a very handy tool to all businesses. Most data scientists and engineers are expected to have a master's in computer science or data science, but there is no shortage of schools with these degrees. New master's degree programs in data science are being added every year making it an available option for many people interested in becoming a data scientist.

## Career Recommendation and Review

When it comes to suggesting which of these three career paths to take, I have considered 4 primary factors:

- Difficulty
- job demand
- salaries
- availability.

### Low Barrier to Entry Career Choice

Getting into an IT professional career for the most part, requires one to be somewhat tech savvy and have a foundation of basic skills such as computer software troubleshooting and working with hardware. As one climbs up the ranks, they really start to learn the ins and outs of the architecture of corporate computer systems. Starting an IT career has responsibilities such as applying patches and updates important enterprise software. Further on, network, software, and infrastructure maintenance and design become the focus. Overall, this career path can pay decently, but it would take some climbing up the ladder to get to that point.

### All Around Career Choice

Software engineering is a solid career path that doesn't take the same amount of education or knowledge as data scientists but can reap similar benefits. Being knowledgeable in programming languages or other development tools can take a fair amount of experience, but software engineering is in demand. Many software engineers go from company to company and negotiate higher salaries as their knowledge of the application life cycle and their toolkit expands. Ultimately, the end of the ladder for some is to be an experienced senior software engineer, but for some it is to oversee the projects and make sure everything runs smoothly. All in all, although software engineering does take more skill to get into than the IT field, it pays more throughout and doesn't require the same knowledge data science does.

### My Personal Recommendation Career Choice

If I were to suggest any of these career paths, I would recommend getting into the data science field. In data science, one starts by analyzing and creating visualizations of data. Then, using scripting languages and sifting databases, creating predictions via machine learning becomes the next step.

The reason why data science is the suggested career is not because of it having better salaries than the others, but solely because of the job demand. Now more than ever, using data is truly the only way to improve a business. Companies are constantly getting data from Internet searches, clicks on specific products, and are harvesting data when users make accounts on websites. The data is then put through analytical tools and machine learning algorithms to help the company improve their operations and develop new products.

It's important to note that getting to the data scientist position is no easy task. It requires a solid foundation in data visualization and scripting languages. On top of that, it will most likely be necessary to have a master's degree or beyond in an area such as computer science, information systems, mathematics or statistics. As time goes on, these higher education requirements will most likely go down but currently 75 percent of data scientists have at least a master's degree <sup>[23]</sup>. There are ways of obtaining a master's via online education so it's not the most difficult part of getting a career within data science. It's easy to agree that data science is the future of computer science careers but with the rising importance of data, data scientists are here to stay.

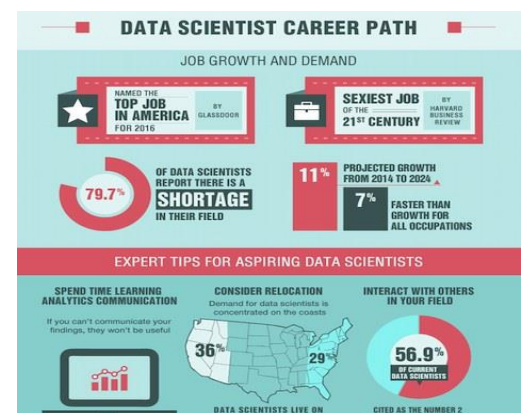


Figure 5: Data Science Job Demand and Growth [22]

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