Chapter 03 Careers in Information Technology

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The quality, relevance, and impact of the products and services output by the technology sector can only be improved by having the people who are building them be demographically representative of the people who are using them.

—Tracy Chou, software engineer at Pinterest

Overview

Information technology now offers a range of attractive career options for workers with a wide variety of interests, skill levels, and career ambitions. See Figure 6. Some of these roles are highlighted in this chapter.

FIGURE 6 — Some of the information technology career options.
Software Development

Perhaps the first career option that comes to mind when thinking of information technology is related to creating these technologies. The majority of these jobs fall in the category of software development. Software developers are the builders of the IT world, writing code and fixing errors in code (called debugging) to either create components for other software developers or applications for end users. There are a wide range of software developer roles, from simple to complex. Relatively simple roles might involve tasks such as using spreadsheets to display annual expense reports for companies. Where complex roles could involve tasks such as automating robots for drug development.¹⁵ Software developer roles include:

- Application development: these developers create user-facing applications that interact with people, take their input, generate reports, and help them make decisions. If you choose this field, you'd most likely either be a front-end developer and create user interfaces that people interact with when they open applications; or you'd be a back-end developer and create linkages between software applications and databases. Many programmers do both front-end and back-end development to increase their versatility and the breadth of available job opportunities.¹⁶

- System software development: these developers build the core technologies used in servers to manage databases, email, and business transactions. They also take care of back-end processes like source-code control and network related issues.

- Mobile application development: these developers build applications for smartphones. This is an exciting field in which developers build applications optimized for the small screens and powerful capabilities (e.g. cameras, payments) of smartphones and tablet computers. This field is growing everyday as most potential applications are yet to be built.

- Embedded developers create software to manage non-PC devices like cars, dishwashers, refrigerators, and Wi-Fi routers. Embedded software is written specifically with a device in mind and controls the overall operation of the device. Embedded software is usually optimized for simple operation, immediate startup, and minimal maintenance. Users typically pay for the software as part of the cost of the product.

Software is assisting human work in more and more areas, and the demand for software developers seems never ending. Writing code and building applications is challenging, and most companies hire software developers who have an engineering or MIS (management information systems) background and know at least a few programming languages, so they can handle a variety of tasks.

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¹⁶ If you are interested in application development, we recommend W3Schools as the starting point, https://www.w3schools.com/ (accessed June 2023), and following their recommended learning trajectory.
IT Infrastructure

All large organizations buy, deploy, and maintain their IT infrastructure, which includes hardware, software, and networking components. All these organizations have an IT Infrastructure group to keep systems up and running and to minimize losses due to unexpected downtime. See Figure 7. Some of the typical job roles supporting this field are systems administrators, user managers, network managers, and email administrators. Employees in these roles come from all academic backgrounds, including those with high school diplomas, associates degrees, and college degrees. Typically, an industry certification in a specific technology helps with initial entry into the profession.

IT Support

An IT support group provides technical support to resolve issues related to computers, phones, networks, printers, and other devices. Support groups communicate with end users and sometimes act as the interface between users and software developers. Typical job roles in this field are support staff, support engineers, business analysts, and support managers. Employees in these roles also come from all academic backgrounds. Many university students work as IT support staff as a starting point into IT careers.

Data Management

This group focuses on storing, structuring, and retrieving data efficiently. They design databases to ensure data is accurate and available for decision-making and strategic planning activities. Typical job roles in this field are database administrators, data architects, data modelers, and cloud specialists. Organizations are now increasingly interested in using their available data to improve decision-making (e.g., which students may benefit most from scholarships), and new roles such as data engineer and data scientist are emerging. Data management involves a mix of general programming abilities and specialized data handling abilities (using programming languages like SQL). Employees in these roles typically come from engineering or MIS backgrounds.

Cybersecurity

Cybersecurity experts keep organizations safe from hackers and malicious users by constantly monitoring threats and taking remedial action. They ensure that all computers and embedded devices in the organization are running the correct versions of software and unauthorized users cannot access systems. As employees can and often do reveal company secrets and information accidentally, cybersecurity experts must also train employees in security best practices to always keep one step
ahead of hackers. Roles in cybersecurity include end-user training and network monitoring. Employees in these roles share many characteristics with employees in IT infrastructure. A critical difference is that employees in cybersecurity also need to be able to act under pressure, when the organization faces an active cybersecurity threat.

**Computer Forensics**

Computer forensics is the collection and preservation of evidence from computers for presentation in courts of law. This field is becoming increasingly important for cops and investigators because computers are used to plan many crimes, for example to locate targets, plan escape routes and communicate with collaborators. Computer forensic experts recover deleted files and track digital information to figure out how a computer, network, or cell phone was used in a crime. With a few keystrokes, they can collect the required proof to connect a criminal to a crime. Most police departments hire cybersecurity experts and many cops take college classes and upskill themselves to become computer forensics experts.

**Internet Infrastructure**

The increase in the number of Internet users and embedded devices presents many challenges and opportunities. In 1980 the Internet barely existed and had only about 200 users. In 2030, about 7.5 billion people across the world will be connected to the Internet. See Figure 8.

In addition, it is expected that there will be 30 billion devices and sensors capable of talking to each other and accomplishing tasks automatically. This network of Internet-connected devices is called the Internet of Things (IoT). IoT will require reliable Internet connection and hardware to remain alert and functioning. This vast network will also require IoT infrastructure technologists, who are
expected to be in high demand. These employees are also expected to share many characteristics with cybersecurity and IT infrastructure employees.

**Research and Development**

As computing and networking becomes increasingly integrated with human life, research and development will be needed to make the IT simpler to use, economical to own, secure to operate, and efficient in using resources. All this will require research and development in all areas related to IT including hardware, software, algorithms, development practices, and user interactivity. While the number of jobs in R&D are not likely to be large, they will be significant drivers of IT growth and can be exciting places to work for people who enjoy exploration and experimentation.

**Careers Supporting IT**

Other than the specific job roles listed above, most organizations also have other roles in IT including business analysts, user-interface designers, architects, engineering managers, quality assurance engineers, testers, and many other roles supporting the core team of developers. All these are great career options.

Even if you do not have any interest in IT and do not wish to work in an IT company, you will need some level of familiarity with technology in any job in the modern age. For example, teachers are expected to know how to use email to communicate with parents, schedule meetings using online calendars, store data about students in excel, share teaching materials using Google Cloud, and use web conferencing technologies to help students. We therefore believe that the lessons in this book are relevant for any career option you choose.

**Skills Needed to Succeed in IT**

The skills needed to succeed in IT are quite similar to the skills needed to succeed in any modern high-performing team or organization. A few basic computer skills and awareness of common tools is expected. We broadly divide the IT skills required in the modern workplace into these five categories:

- **Soft skills**
- Organizational and project management skills
- Basic computer skills
- Familiarity with office tools
- Web and collaboration skills
**Soft Skills**

To get any work done, you need to communicate, listen, manage time, honor your commitments, be respectful of others, and show empathy for your colleagues. These interpersonal skills are called soft-skills and affect your ability to work effectively with other people in a modern workplace. Soft skills are less important at the time of starting a career. However, as you progress in your career and take responsibility for guiding colleagues and junior employees, soft skills become increasingly important, eventually becoming more important than the core technology expertise. All the years of hard work trying to acquire technical skills may get derailed if you do not have the necessary soft skills to become a successful team leader. Empathy, compassion, honesty, and the ability to celebrate your coworkers’ successes make you a valuable partner and someone others will always want to have on their team.

Even when other team members don't share your opinion, you should be able to express yourself and disagree with others without being disagreeable. You should be able to regulate your emotions when receiving critical feedback and try to see the feedback as an improvement opportunity. Giving constructive feedback to help other team members grow is also an asset. These skills will help you in every walk of life, not just within the boundaries of your workplace. For those who have mastered soft skills, the workplace is an environment full of positivity, a place where you can be productive while having fun.

**Organizational and Project Management Skills**

Most modern jobs require dealing with complexity and shifting goals. Dealing with this requires organizational and project management skills. You may need to coordinate with your team and potentially even with vendors and customers to solve common problems. You may need to gather business and functional requirements and test cases. To see this in context, imagine you and a group of friends decide to build a gaming PC. You will get together and define its capabilities, the amount of money you are willing to spend, and how soon you need to build the PC. You can think of the above parameters as your high-level requirements. High-level requirements are typically called business or product requirements. You can break the business requirements into more detailed requirements, like the type of CPU, amount of RAM, storage, the number of disk drives, and the size of the box. These are your lower level or functional requirements. You can then define test cases that will ensure the computer works as expected once it is assembled. Typically, validation results are stored as test results. Once you have defined all your requirements (business, functional, and test cases), you will identify a list of tasks and the order in which they need to be accomplished to build the PC. For example, if you buy the box because it was on sale, but the box doesn't have space for all your components, you would either have to compromise on your PC capabilities, or buy another box to accommodate the necessary components and throw away the box which you thought was a great buy.

Working with a team requires additional activities to ensure that each item completes on time. You must provide regular (daily, weekly, or monthly) updates to your team, management, and customers in order to deliver results most efficiently. Thankfully, you can take advantage of Excel and other project management tools to give yourself a head start. You will learn more about Excel in **Chapter 9, “Introduction to Spreadsheets.”**

**Basic Computer Skills**

In any modern workplace, you will usually be assigned a computer on your first day at work, which you
will use to do most of your office work. You must know how to turn the device on, shut it down, connect it to your office network, and install and upgrade software as directed by the company’s IT group. You must also be familiar with common peripherals like monitors, external keyboards, mousepads, cameras, and headphones. To be able to make copies of documents, you will need to connect to office printers, be aware of common printer settings, and know how to send files for printing.

As most of the work you do on your computer will be stored in files, you must know how to create files, save changes to files, and store files in the correct folders. You should know about common file extensions and what software program will open a particular file type. We will discuss more about files and file management in Chapter 6.

As a lot of meetings are scheduled online, you need to know how to create and accept meeting invitations using common calendaring tools. If a meeting is in a physical room, you will also need to know how to book a room and what hardware will be necessary for the meeting.

While some of the above jobs may sound daunting, most offices have people who will help you with the initial setup and find solutions to malfunctioning hardware and software. For example, your IT support team can help you connect to your printer. The IT support team is responsible for ensuring that employees are productive with IT and don’t waste time fixing minor technical issues.

**Familiarity with Office Tools**

Your office computer will most likely come equipped with some common office software like Microsoft Office, G Suite, and Outlook. You will use these tools to create documents, spreadsheets, and presentations, and to send and receive emails. Here’s a list of common office tools you should know how and when to use. You’ll learn more about these tools in later chapters.

<table>
<thead>
<tr>
<th>Product</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microsoft Word and Google Docs</td>
<td>Write letters and create invoices, documentation, and job offers.</td>
</tr>
<tr>
<td>Microsoft Excel and Google Sheets</td>
<td>Store data in rows and columns to record sales, do calculations, summarize information, and create reports and invoices.</td>
</tr>
<tr>
<td>PowerPoint and Google Slides</td>
<td>Create presentations for colleagues, managers, and customers.</td>
</tr>
<tr>
<td>Outlook and Gmail</td>
<td>Send and receive emails and manage meetings.</td>
</tr>
</tbody>
</table>

**Web Skills**

Most jobs will expect you to be proficient in using the web to do your daily tasks. For example, you may have to use Google Maps to find directions to the nearest warehouse or factory. You may have to log in to a client’s accounts tool to submit your invoices. The starting point to each of these skills is the ability to launch a browser, organize...
commonly used links as bookmarks, log into websites, and follow instructions. Popular browsers are depicted in Figure 9.

Wi-Fi Access

A web browser is going to be of no use unless your computer is connected to the Internet. Users now generally connect to the Internet using wireless networks, commonly called Wi-Fi. Most libraries, schools, universities, and even coffee shops offer free Wi-Fi. Wi-Fi is a wireless network that allows phones, laptops, and desktops to connect wirelessly to the Internet. Most Wi-Fi networks are password protected and available only to patrons. At any new location, you should be able to talk to the staff and get the Wi-Fi name and password. You will then need to select the correct Wi-Fi name on your computer from a list of available Wi-Fi networks and enter the appropriate credentials to join the network. See Figure 10.

Below are three Wi-Fi connection icons found on your computer and their meanings.

- ![Wi-Fi connected icon](image)
  - You are connected to Wi-Fi and the Internet.

- ![Wi-Fi connected but no internet icon](image)
  - You are connected to Wi-Fi, but there is no Internet connection.

- ![Wi-Fi not connected icon](image)
  - You are not connected to the Internet. Click to see the available Wi-Fi networks.
Collaboration Skills

Most offices rely heavily on collaboration software for employees to connect with each other easily. Chat software like Microsoft Teams or Slack, and web conferencing tools like Zoom, Webex, and Google Hangouts are popular. You are probably already using variations of these in your personal life on personal mobile devices to send messages to and meet with friends. WhatsApp, Discord, and FaceTime are other popular chat/collaboration/web-conferencing tools.

In the post-Covid world, technology jobs have become more flexible and can be onsite, remote, or hybrid. If a job is onsite, then you are required to go to work. However, if you get a remote job you’ll be a virtual worker who must attend online meetings and be available on Teams or Slack to participate in discussions with your coworkers. The work-from-home trend that started with the Covid lockdowns is a novel development. It will be interesting to see how it affects employee productivity in different tasks and whether employees end up working longer hours, compensating for the comfort of home.

A career choice is one of the most important decisions you will make in your life. It will affect how you will be compensated, where you can work, how you will balance your life and work, and what you will do during most of your waking hours. Therefore, do your best to be deliberate about the choice. Before you make a career choice, assess your skills to understand your aptitude, likes, and dislikes. Being good at something as a hobby may not necessarily mean you'll enjoy it as a career that you will be doing every day for decades. This is particularly true if the activity is not well compensated in the market. While making a career choice without accounting for your financial needs may not be smart, choosing a career option solely for money may also prove to be disastrous in the long run. This is particularly true if you do not like the hours, stress, or customer interactions involved in the job. If you are unsure of your career choices, consider volunteering for non-profit groups and joining school clubs related to the career choices. This will give you a better feel for the job roles associated with the field. Medical schools, for example, expect students to have spent considerable time volunteering within medical establishments to know what they are getting into before trying to get into med school.\(^{17}\) This is because they have experienced high quit rates within their programs when students simply join because of the prospect of entering a high-paying career.

For most students taking this class, we believe you should consider a career in IT. If you are good academically, particularly in classes like math and science that require structured thinking, we believe you should consider careers in software or hardware development. Most employees we know like the work environment and find the work meaningful. Certainly, the jobs in this field offer good salaries and the number of jobs will continue to grow in the foreseeable future. See Figure 11. Also, the United States is a dynamic economy where 60% of the jobs in 2018 did not exist in 1940.\(^ {18}\) IT is even more dynamic, and we expect many job types not listed above to be important by the time you enter the workforce.

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You will most likely need postsecondary education to have a career in IT. Postsecondary education is any education you receive after high school. You should start planning for postsecondary education as soon as you are ready, probably as early as middle school. Gathering information may be the first step to figuring out the trainings, certifications, or degrees necessary to get to your goal. You can do the following to get a head start:

- talk to friends with similar interests;
- meet with your school counselor;
- talk to adults who work in IT;
- search on the web.

A few organizations do offer summer internships to school students with the idea of grooming future IT professionals. Both volunteering and internships can prove to be especially advantageous. If you are thinking about applying for a two- or four-year college, you'll be able to make your resume stand out by pitching your experience.
<table>
<thead>
<tr>
<th><strong>Back-end Developer:</strong></th>
<th>Programs who create linkages between software applications and databases</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Business Analyst:</strong></td>
<td>Person responsible for managing information and synthesizing it to understand what decisions to take in the company</td>
</tr>
<tr>
<td><strong>Cloud Specialist:</strong></td>
<td>Individuals who can advise businesses on cloud computing solutions</td>
</tr>
<tr>
<td><strong>Computer:</strong></td>
<td>A programmable computing device capable of receiving input, manipulating data, and outputting information</td>
</tr>
<tr>
<td><strong>Computer Forensics:</strong></td>
<td>Collection and preservation of evidence from computers for presentation in courts of law</td>
</tr>
<tr>
<td><strong>Cybersecurity:</strong></td>
<td>Field of IT that encompasses the security of information technology using policies and procedures</td>
</tr>
<tr>
<td><strong>Data:</strong></td>
<td>Representation of facts in a formalized manner suitable for communication, interpretation, or processing by humans or by automatic means</td>
</tr>
<tr>
<td><strong>Data Architect:</strong></td>
<td>Person who develops the systems involved in data capture, storage, and analysis</td>
</tr>
<tr>
<td><strong>Data Management:</strong></td>
<td>Ensure data security, reliability, and accuracy of data</td>
</tr>
<tr>
<td><strong>Data Modeler:</strong></td>
<td>Person responsible for analyzing data and identifying relationships that can improve databases</td>
</tr>
<tr>
<td><strong>Database:</strong></td>
<td>Software to store and retrieve structured data</td>
</tr>
<tr>
<td><strong>Email Administrator:</strong></td>
<td>Person responsible for maintaining an organization's email systems</td>
</tr>
<tr>
<td><strong>Embedded Developer:</strong></td>
<td>Software developers who create software for non-PC devices; embedded software is written specifically with a device in mind</td>
</tr>
<tr>
<td><strong>Front-end Developer:</strong></td>
<td>Programmers who create user interfaces that people interact with when they open applications and focus on the user experience</td>
</tr>
<tr>
<td><strong>Hardware:</strong></td>
<td>The physical and often modular components of a computer system</td>
</tr>
<tr>
<td><strong>Information Technology:</strong></td>
<td>Any equipment or system responsible for data manipulation; also refers to the disciplines of science and engineering that interact with these systems and data</td>
</tr>
<tr>
<td><strong>IT Support:</strong></td>
<td>Individuals who provide technical support to resolve issues related to computers, phones, networks, printers, and related devices</td>
</tr>
<tr>
<td><strong>Keyboard:</strong></td>
<td>A physical or digital device capable of communicating with a connected computer system through assigned key inputs</td>
</tr>
<tr>
<td><strong>Network Manager:</strong></td>
<td>Person responsible for a firm's network architecture</td>
</tr>
<tr>
<td><strong>Networks:</strong></td>
<td>Computers that are connected through either wired or wireless means with the purpose of sharing data</td>
</tr>
</tbody>
</table>
Non-PC Devices: Commonly referred to as embedded systems, these are devices that contain computer hardware but are developed and programmed for specific functions.

Programming Language: An integrated set of commands used to write software.

Project Management: The efficient coordination of a business’s resources to accomplish its objectives.

Smartphone: A small form factor computer combined with a mobile phone based around touch screen input.

Soft Skills: Skills related to human interaction and reaction through communication and perception.

Software: Instructions that computer hardware can interpret and execute in order to achieve desired tasks.

Support Engineer: Engineers who develop, maintain, and troubleshoot software and hardware used within an organization.

Support Manager: Person focused on helping end users with computer resources.

System: Separate components working together to fulfill a function.

Systems Administrator: Person responsible for implementation, maintenance, and security of a firm’s computers.

Tablet Computer: Larger and more powerful mobile computer than a smartphone.

User Interface: Any medium that allows users to interact with computers.

User Manager: Person responsible for managing computer privileges given to individuals within the organization.
Chapter Case

Anthony’s Learners Permit

Let’s look again at the case from Chapter 2.

Anthony finally turned 15 years old and he was ready for his Florida Learners Permit (restricted driver’s license). The permit was required for him to drive the old family car parked in the driveway of his house. He had just successfully completed the required online Drug and Alcohol (DATA) course and Department of Motor Vehicle (DMV) Permit Test. This was the day he had waited for so long.

Anthony opened up an Internet browser on his laptop and navigated to the Florida Learners Permit information guide (https://www.dmvflorida.org/learners-permit/) to verify he had everything ready to go before his parents would take him to the DMV to get his restricted license. As he looked over the website, he noticed an interesting statement:

“After completing both the DATA Course and Permit Test you are then eligible to get a Florida Learners Permit. The DMV approved course and test providers automatically transmit your information to the DMV upon your completion.”

Anthony thought to himself, “I hope all of my online DATA course and Permit Test information gets transmitted to the DMV before my parents take me to get my license today.”

As Anthony and his parents walked into the entrance of the local DMV office, he noticed that he was surrounded by technology everywhere. There were so many systems displaying and collecting information. All he could think about was how amazing the first drive with his new learners permit would be.

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Question 1: What types of careers do you think are required for people to develop and manage the information technology used to issue Anthony’s learners permit.