Feasibility Study:

Master of Science in Computer Engineering

South Carolina State College

Submission by:

Center for Research and Strategy

October 2018

Data and names have been changed for the illustrative use/purpose of this report

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I. Program Overview

South Carolina State College currently offers a Master of Science in Computer Engineering that is delivered in an online format. The program has seven areas of specialization and is especially strong in electronics and power systems, nanoelectronics and photonics, and communications and signal processing, among other topics. The GRE is required for all applicants to the program, though there is no posted minimum score required for entry into the program. The program is currently ranked 64th in *US News and World Report's* ranking of the nation's best engineering schools and is ranked 28th for Computer/electronic/communications engineering graduate programs online.

II. Objective

SC State has requested the University Professional and Continuing Education Association (UPCEA) and its Center for Research and Strategy to provide information concerning the current market for a Master of Science in Computer Engineering. The University would like greater information on the potential market and its size, the competitive environment, and the job market for program graduates. The goal of this feasibility analysis is to answer the following questions:

- What is the condition of the market for an online Master of Science in Computer Engineering?
- What do employers in the field need to see from program graduates?
- Is there information available that could impact content development or course offerings?
- What is the size and magnitude of the competition?

A feasibility analysis is a cost-efficient and insightful exploratory research method regarding program assessment, design, and delivery—an internal stakeholder engagement and planning adaptation enabler.

III. Methodology

UPCEA and its Center for Research and Strategy conducted a feasibility analysis that included a review of Computer engineering trends, occupational demographics, internet and library scans, and in-depth interviews with eight key opinion leaders from the computer engineering industry representing a variety of organizations throughout the country, with a focus on the Southeast. The analysis was done at four levels: the Charlotte–Concord– Gastonia (MSA) and the Charlotte-Gastonia region as the local market, or first primary region; South Carolina and North Carolina as the second primary region; the Southeastern United States, defined as Virginia, Kentucky, Tennessee, North Carolina, South Carolina, Georgia, Alabama, Mississippi, Louisiana, Arkansas, and Florida as the secondary region; and the United States as the tertiary region.

IV. Key Findings

- Within the local marketplace, **computer engineers and electronics engineers are projected to see 18% and 17% growth, respectively, from 2018 to 2028.** Both occupations have a median salary above $100,000 in the region.

- Forecasted growth is positive for both occupations in every region, including South Carolina and North Carolina (19% and 16% respectively), the Southeast (14% and 8% respectively), and nationally (10% and 5% respectively). Forecasted job growth is stronger for Computer engineers than it is for electronics engineers.

- The cities that currently employ the most select computer engineering occupations include the Los Angeles-Long Beach-Anaheim MSA (17,775), the New York-Newark-Jersey City MSA (13,928), and the Dallas-Fort Worth-Arlington MSA (11,799). **The Charlotte MSA is tied with the Miami MSA for the highest forecasted job growth percentage from 2018 to 2028 among the top 30 MSAs employing select Computer engineering occupations.**

- **Five of the top 10 cities in the country with job postings for select computer engineering professionals with a master's degree are in California**, including the top three cities: San Diego, El Segundo, and San Jose.

- Nationwide, the top job titles for select computer engineering occupations include design engineers (architecture and engineering), senior computer engineers, systems engineers (architecture and engineering), radio frequency engineers, and controls engineers.

- Competitive analysis for master's programs in Computer engineering **identified four competing programs in South Carolina and North Carolina, none of which are available online.** Five other potential competitors were identified in the southeastern United States, all of which are offered online. Programs in the Southeast range from 30 to 33 credits and have an average cost of $20,863 for in-state students.

- There are many competitors nationwide that offer both online and on-campus master's degrees in computer engineering. The competitive analysis highlights 11 competing national programs which range from 21 to 45 credits and cost an average of $45,627 for out-of-state students. Completions in 2017 ranged from 29 to 446.

- Only **two of the 19 programs profiled in the competitive analysis do not require the GRE** for admission: Penn State University and the University of Colorado Boulder.

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- Computer engineering trends most commonly mentioned by opinion leaders include renewable and solar energy developments. These center around various applications within the field of solar energy, and specifically in the photovoltaic sector, but also tie into the electric vehicle aspect of renewable energy and the project of building and maintaining charging stations everywhere.

- Other trends mentioned include artificial intelligence, quantum computing, wireless, and the Internet of Things (IoT). Critical systems and data centers in general were cited by one opinion leader who said that there is a great deal of communication and collaboration between computer engineers and the technicians who design some of these systems.

- Almost all opinion leaders described a shortage of job applicants in the field, with many openings that have not been filled. Several mentioned that there are many open job positions at their places of work, and that it can be very hard to find qualified people to fill all of them. Several leaders mentioned that while candidates can be hard to find, once they are found, they are often of high quality.

- Most individuals felt that the proposed course list was solid and robust. Overall, the most important courses were Wireless Communications Systems and Power Systems Stability and Control. Other courses mentioned included having Strong Foundations in Math and Physics, Electromagnetic Capability and Electromagnetic Interference, and Engineering Management.

- While one opinion leader reported being unsure or unfamiliar with the reputation of SC State College, all of the other respondents felt that the reputation of SC State would add to the strength of its program. Individuals mentioned having family members and coworkers who attended SC State and that they were always top-quality employees.

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V. Recommendations

Consider Some Curriculum and Specialization Adjustments: SC State should review its current program regarding content, nomenclature, and marketing. While there appears to be a demand in the field and growth in the profession, the field of employee retention and development is undergoing significant changes, as was identified by several opinion leaders. This may indicate a change towards more progressive content, a name that reflects these changes to the profession or workforce, and careful planning to deliver the credential to both current employees in the field, and those of the future.

Find A Unique Niche or Specialty: While it appears that demand is strong for the SC State master's degree in computer engineering, several individuals mentioned that many typical jobs as a computer engineer do not require a master's degree. It was suggested that an individual looking to enter research and development, or certain subspecialties within the field, may benefit more from this program. Some of these specialties identified include renewable energy types, artificial intelligence, and quantum computing. SC State should look to highlight and market to these specialties in order to maintain a strong audience.

Have a Strong Foundation in Math and Physics: Although most of the proposed course topics were well-received by opinion leaders, several stressed that the basics of math and physics are more important and relevant than ever. The university should ensure that these classes are well taught and cover a wide-range of topics to ensure that graduates are grounded in these core courses, as well as stressing that courses and messaging integrate mathematical modeling and physics principals.

Add Lab and Hands-On Component: SC State should include hands-on lab courses and require a practicum for graduation. A proposed lab component for circuits or various hands-on courses could be taught as intensive programs during a summer or winter break and would give students the opportunity to learn and experiment in a face-to-face environment. Requiring a practicum for completion gives potential program graduates an edge over their competition in terms of work experience, and provides them with an opportunity to complement their online classroom studies.

Leverage the University's alumni network to promote the offering and secure early applications: Rely on existing means of contacting alumni to alert them to the new program's availability with invitations to consider enrolling and to help identify opportunities to promote the program in their workplaces. This group could also provide initial targets when recruiting industry advisors for the program. In addition to alumni of

SC State's engineering programs, cross-reference graduates in related fields who may personally value the opportunity to add this competency or will know of others in their organization and professional networks who could benefit.

Build on Strength of SC State and Capitalize on Lack of Local Online Competitors in South Carolina State: SC State College has built an extremely strong reputation, as is evident by opinion leaders' evaluation. Opinion leaders across the board felt that the name of SC State carried an excellent reputation not only in the region, but also on a national scale. SC State should look to continue to build on its strong reputation by ensuring that students are proficient in the proposed subject matter, making them high-quality job applicants. While there are several other competitors offering master's programs in the state of South Carolina, none are available online which should provide SC State an excellent opportunity to enlarge its market.

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VI. Trends in Computer Engineering

Computer Engineering as an Industry

With the rising demand for sustainable business practices, increasingly unstable consumption of electricity at the consumer level, and an infrastructure being reinvented on the basis of smart connectivity, Computer engineering is a field in which the topics listed will be leading concerns in the future. Because of these, trending issues within the computer engineering community will include renewable energy, the smart management of electricity generated by those renewable resources through new battery development, and wireless power transfer coupled with the Internet of Things to enable the development of smart cities.

Renewable Energy

Renewable energy sources generated 17% of all electricity used in the United States in 2017.[1] As the push to eliminate U.S. fossil fuel dependency continues, there is an increasing number of sustainable ways to generate electricity. Because of this push, computer engineers have a growing number of diverse fields to enter. These fields include the implementation of hydropower which accounts for 44% of all renewably generated electricity, wind energy which accounts for 37%, and the use of solar, biomass, and geothermal which accounts for the rest.[1] It is important to note that half of all new Computer generating capacity in the U.S. is sourced by renewable energy.[2] Looking ahead, the U.S. is capable of achieving 80% of the country's electric needs through renewable sources by 2050.[3] While this remains on the horizon, it will remain a trending topic within the industry.

Smart Electricity Management: Smart Grids

Smart electricity management is becoming an issue within the computer engineering community because of changing electricity usage trends. The change in these trends is especially dramatic at the individual consumer level.[4] The current state of the U.S. electric infrastructure is being pushed beyond what it was originally meant to do, and there has been pressure to create a smarter grid in order to support greater consumption demands. A smarter grid is only made possible through two-way technologies such as Phasor Measurement Units (PMUs), a sensor that allows operators to control and assess grid stability remotely. Other technologies will immediately signal to an operator when an outage occurs in addition to rerouting in order to fix the problem autonomously, and some technologies can even store power in the grid to meet consumer demand when necessary.[5]

[1] https://www.eia.gov/energyexplained/index.php?page=electricity_in_the_united_states
[2] https://www.forbes.com/sites/rrapier/2018/05/06/renewable-sources-account-for-most-new-u-s-power-capacity/#1dd02a685971
[3] https://www.ucsusa.org/clean_energy/smart-energy-solutions/increase-renewables/renewable-energy-80-percent-us-electricity.html
[4] https://www.energy.gov/oe/activities/technology-development/grid-modernization-and-smart-grid
[5] https://www.sealevel.com/2018/09/05/grid-resilience-three-key-strategies-to-make-the-grid-stronger/

Battery Technology

There has been a growing importance in the ability of the country's electric infrastructure to support large spikes in usage, and the best way to accomplish that is storing electricity in batteries. However, one of the largest issues of the current electric infrastructure is the inability to store electricity at scale.[6] This issue will continue to grow in severity as renewably sourced electricity continues its upward trend because many of the renewable sources of energy are incredibly unstable since they are controlled by natural forces. Current batteries are lithium-ion, and their downfall is that they lack durability. Recently, however, there has been a breakthrough in the development of nanowire batteries. Where lithium-ion batteries last a few thousand charges, nanowire batteries can last upwards of two-hundred thousand charges, but the obstacle is getting nanowire batteries into production in a cost-effective manner.[7] Regardless of the battery type, the inability to store electricity on a large scale is an issue that will only grow in size within the Computer engineering community.

Wireless Power Transfer & the Internet of Things (IoT)

To provide an alternative to battery usage, the notion of wireless power transfer, especially in conjunction with small Internet of Things (IoT) devices, is on the horizon for some of consumers' charging needs. Wireless power is energy transfer over the air using radio frequency. The most lucrative and appealing use of wireless power transfer is its application to IoT devices to create smart cities.[8] It is expected that global spending on smart city technology will reach $135 billion by 2021.[9] Considering that 60% of people are expected to be living in cities by 2050, this is a quickly spreading trend that is impacting the world of Computer engineering. Because there are thousands of devices that have the potential to be connected to the IoT in order to create such smart cities, the development of smart city technology was the planned focus of the 2018 Consumer Electronics Show (CES). [10] Within the next 10 years, research presented by the Consumer Technology Association (CTA) declares that there will be 88 fully-developed smart cities globally, and these will include technologies such as intelligent electricity grids, smart cities becomes realized.

[6] https://www.sealevel.com/2017/12/14/4-important-trends-in-electrical-engineering/
[7] https://www.sealevel.com/2018/01/03/three-battery-innovations-to-follow-in-2018/
[8] https://www.sealevel.com/2018/05/15/smart-and-connected-communities-saving-lives-with-iot-and-smart-cities/
[9] https://www.techrepublic.com/article/smart-cities-the-smart-persons-guide/
[10] http://www.connectingindustry.com/ElectricalEngineering/smart-cities-not-just-a-pipedream.aspx

VII. Occupational Analysis

For this research, computer engineers and electronics engineers were selected to illustrate the current occupational marketplace for individuals who would benefit from SC State's Master of Science in Computer Engineering program. While this is not an exhaustive list of computer engineering–related professions, the select occupations do provide valuable insight into the overall market while demonstrating potential career paths for professionals with a master's degree. This report presents occupational and demographic information at four levels: the Charlotte MSA and the Durham-Chapel Hill region as the local market or first primary region; South Carolina and North Carolina as the second primary region; the Southeastern United States, defined as Virginia, Kentucky, Tennessee, North Carolina, South Carolina, Georgia, Alabama, Mississippi, Louisiana, Arkansas, and Florida, as the secondary region; and the United States as the tertiary region. All of the following data is taken from Economic Modeling Specialists International (Emsi) from the 2018.4 data set.

Local Market (Primary Region #1)

The first section of the occupational analysis examines historical and forecasted data for select Computer engineering occupations in the Charlotte MSA and the Charlotte-Gastonia region. Table 1 details the historical demand for select Computer engineering occupations in the local market. From 2008 to 2018, Computer engineers experienced a 41% increase in growth. Electronics engineers increased 11%.

Table 1: Historical Demand for Select Computer Engineering Occupations in the Local Market

Occupation	Jobs		Change		Annual Openings
	2008	2018	#	%	
Computer Engineers	1,729	2,437	708	41%	226
Electronics Engineer, Except Computer	1,346	1,496	150	11%	136
	3,075	3.933	858	28%	362

Table 2 highlights the projected future demand for select Computer engineering occupations in the local market. From 2018 to 2028, Computer engineers are projected to experience 18% growth. While this is a large increase, it is less than half of that experienced over the previous 10 years. Electronics engineers, however, are expected to see 17% growth. Average median salary is $104,505.

Table 2: Future Demand for Select Computer Engineering Occupations in the Local Market

Occupation	Jobs		Change		Annual Openings	Median Salary
	2018	2028	#	%		
Computer Engineers	2,437	2,885	448	18%	214	$103,500
Electronics Engineer, Except Computer	1,496	1,747	251	17%	128	$106,142
	3,933	4,632	699	18%	342	$104,505

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Table 3 examines the projected demand for master's degrees in select Computer engineering occupations in the local market. Nationwide, in 2018 24.1% of professionals in the select Computer engineering occupations hold a master's degree. In the local market, due to workers retiring or otherwise permanently leaving the occupation, it is projected that there will be 272 annual replacement job openings. Assuming that education demographics hold constant among individuals leaving the occupation, 24.1% of those individuals should have a master's degree, representing 66 positions. Those openings will likely be filled by someone with a master's degree.

Table 3: Projected Demand for Master's Degrees in Select Computer Engineering Occupations in the Local Market

Occupation	National Educational Attainment (2018)		Annual Replacement Jobs	Master's Holders Needing Replaced Annually
	% with a Master's	% with a Bachelor's		
Select Computer Engineering Occupations	24.1%	49.3%	272	66

Figure 1 highlights job postings in the local market from January to September 2018 for select Computer engineering occupations that require a master's degree. In total, there were 297 unique postings which were posted a total of 1,539 times, resulting in a posting intensity ratio of 5:1. The posting intensity ratio is above the regional average for all occupations (4:1), which suggests that companies in the region are putting above average effort into hiring these positions.

Figure 1: Job Postings for Select Computer Engineering Occupations in the Local Market

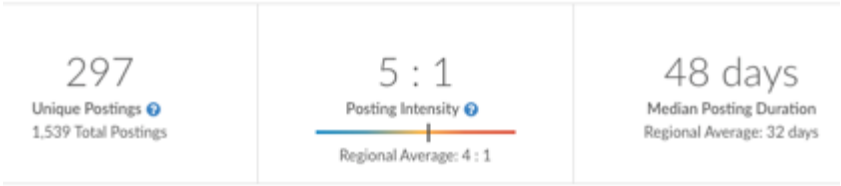

Figure 2 on the following page illustrates the top 10 cities with job postings in the local market from January to September 2018 for select Computer engineering occupations that require a master's degree. During that time, Charlotte had 193 unique postings, more than that of the other cities combined. Two cities, Morrisville and Wendell, had posting intensity ratios of 6:1, the highest among the top cities. This suggests employers in those two cities are more aggressively trying to hire Computer engineers compared to other cities in the region.

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Figure 2: Top Cities with Job Postings for Select Computer Engineering Occupations in the Local Market

City	Total/Unique (Jan 2018 - Sep 2018)	Posting Intensity	Median Posting Duration
Charlotte, NC	981 / 193	5 : 1	48 days
Morrisville, NC	200 / 33	6 : 1	56 days
Cary, NC	148 / 31	5 : 1	35 days
Durham, NC	86 / 16	5 : 1	50 days
Wendell, NC	84 / 14	6 : 1	62 days
Knightdale, NC	15 / 4	4 : 1	22 days
Chapel Hill, NC	15 / 3	5 : 1	2 days
Roxboro, NC	6 / 2	3 : 1	3 days
Wake Forest, NC	4 / 1	4 : 1	13 days

Figure 3 details job titles among job postings in the local market from January to September 2018 for select Computer engineering occupations that require a master's degree. Design engineers (architecture and engineering) was the most common job title with 42 unique posts, followed by senior Computer engineers (37) and signal processing engineers (14). Signal processing engineers and electronics engineers both had a posting intensity ratio of 7:1, the highest among the top 10 job titles which suggests companies are more aggressively pursuing those job titles compared to others.

Figure 3: Top Job Titles for Select Computer Engineering Occupations in the Local Market

Job Title	Total/Unique (Jan 2018 - Sep 2018)	Posting Intensity	Median Posting Duration
Design Engineers (Architecture and Engineering)	151 / 42	4 : 1	32 days
Senior Electrical Engineers	235 / 37	6 : 1	54 days
Signal Processing Engineers	93 / 14	7 : 1	82 days
Power Systems Engineers	31 / 12	3 : 1	53 days
Controls Engineers	39 / 10	4 : 1	28 days
Product Engineers	49 / 10	5 : 1	17 days
Systems Engineers (Architecture and Engineering)	36 / 10	4 : 1	14 days
Staff Engineers	22 / 8	3 : 1	84 days
Electronics Engineers	54 / 8	7 : 1	59 days
Project Engineers (Architecture and Engineering)	40 / 8	5 : 1	25 days

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Figure 4 illustrates the top hard skills among job postings in the local market from January to September 2018 for select computer engineering occupations that require a master's degree. There is some variation between some of the hard skills employers are looking for and the skills that the workforce highlights in its online résumés and profiles. Computer engineering had the biggest difference, being mentioned in 58% of job posts, but only 28% of workforce profiles. Other disconnects include automation (22% of postings vs. 12% of profiles), electronics (21% of postings and 16% of profiles), and systems design (14% of postings and 7% of profiles). It is important to note that skills associated with workforce profiles represent all education and experience levels which could explain part of the discrepancy between job postings and workforce profiles.

Figure 4: Top Hard Skills for Select Computer Engineering Occupations in the Local Market

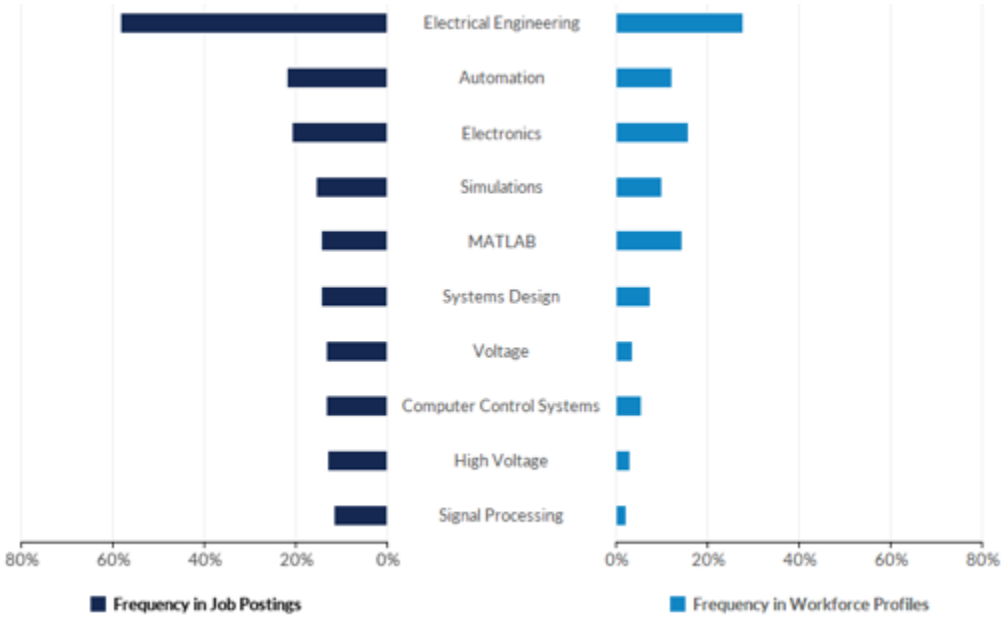

Figure 5 on the following page highlights the top companies with job postings from January to September 2018 for select computer engineering occupations that require a master's degree. Duke Energy Corporation had the highest number of unique offerings (27), followed by ABB LTD (25) and Siemens AG (22). Deere and Company had the highest posting intensity ratio at 13:1, which indicates that the company is putting in above average effort toward filling its openings.

Figure 5: Top Companies with Job Postings for Select Computer Engineering Occupations in the Local Market

Company	Total/Unique (Jan 2018 - Sep 2018)	Posting Intensity	Median Posting Duration
Duke Energy Corporation	204 / 27	8 : 1	25 days
ABB LTD.	134 / 25	5 : 1	39 days
Siemens AG	95 / 22	4 : 1	43 days
Eaton Corporation	152 / 22	7 : 1	92 days
Northrop Grumman Corporation	84 / 20	4 : 1	17 days
General Electric Company	28 / 12	2 : 1	65 days
Aerotek, Inc.	81 / 8	10 : 1	22 days
Burns & McDonnell, Inc.	24 / 7	3 : 1	84 days
Deere & Company	77 / 6	13 : 1	122 days
Kforce Inc.	37 / 6	6 : 1	89 days

Statewide Market (Primary Region #2)

The second section of the occupational analysis examines historical and forecasted data for select Computer engineering occupations in the states of South Carolina and North Carolina. Table 4 details the historical demand for select computer engineering occupations in the state. Between 2008 and 2018, Computer engineers experienced a significant increase in growth, registering a 31% increase. Electronics engineers saw minimal growth at 2%.

Table 4: Historical Demand for Select Computer Engineering Occupations in South Carolina and North Carolina

Occupation	Jobs		Change		Annual Openings
	2008	2018	#	%	
Computer Engineers	4,388	5,764	1,376	31%	534
Electronics Engineer, Except Computer	3,491	3,553	62	2%	326
	7,879	9,317	1,438	18%	860

Table 5 on the following page highlights the projected future demand for select computer engineering occupations in South Carolina and North Carolina. From 2018 to 2028, Computer engineers are projected to experience 18% growth, while electronics engineers are also projected to see strong growth of 16%. The median salary for both occupations is above $95,000.

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Table 5: Future Demand for Select Computer Engineering Occupations in South Carolina and North Carolina

Occupation	Jobs		Change		Annual Openings	Median Salary
	2018	2028	#	%		
Computer Engineers	5,764	6,834	1,070	19%	508	$95,472
Electronics Engineer, Except Computer	3,553	4,111	558	16%	301	$96,283
	9,317	10,945	1,628	17%	809	$95,781

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Table 6: Projected Demand for Master's Degrees in Select Computer Engineering Occupations in South Carolina and North Carolina

Occupation	National Educational Attainment (2018)		Annual Replacement Jobs	Master's Needing Replaced Annually
	% with a Master's	% with a Bachelor's		
Select Computer Engineering Occupations	24.1%	49.3%	643	155

Figure 6 highlights job postings in South Carolina and North Carolina from January to September 2018 for select Computer engineering occupations that require a master's degree. There were 584 unique postings which were posted a total of 2,952 times, a posting intensity ratio of 5:1. The posting intensity ratio is above the statewide average for all occupations (4:1).

Figure 6: Job Postings for Select Computer Engineering Occupations in South Carolina and North Carolina

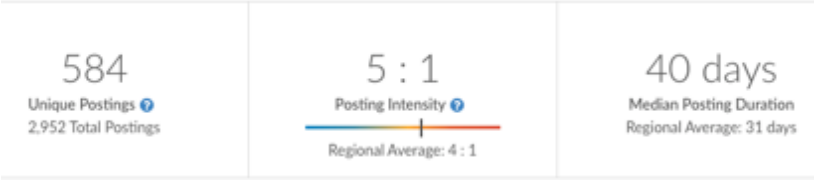

Figure 7 on the following page illustrates the top 10 cities in South Carolina and North Carolina with job postings from January to September 2018 for select computer engineering occupations that require a master's degree. During that period, Charlotte had 193 unique postings, followed by Charlotte (93) and Morrisville (33). Wilson had the highest posting intensity ratio (9:1), which suggests employers in that city are trying to fill their openings more aggressively.

Figure 7: Top Cities with Job Postings for Select Computer Engineering Occupations in South Carolina & North Carolina

City	Total/Unique (Jan 2018 - Sep 2018)	Posting Intensity	Median Posting Duration
Charlotte, NC	981 / 193	5 : 1	48 days
Charlotte, NC	512 / 93	6 : 1	37 days
Morrisville, NC	200 / 33	6 : 1	56 days
Greensboro, NC	143 / 32	4 : 1	52 days
Cary, NC	148 / 31	5 : 1	35 days
Durham, NC	86 / 16	5 : 1	50 days

Some data hidden

Figure 8 details job titles among job postings in South Carolina and North Carolina from January to September 2018 for select Computer engineering occupations that require a master's degree. Design engineers (architecture and engineering) was the most common job title with 77 unique posts, followed by senior Computer engineers (58) and systems engineers (27). Radio frequency engineers had a posting intensity ratio of 9:1, the highest among the top 10 job titles, again suggesting that companies are more aggressively trying to fill those openings than other job titles.

Figure 8: Top Job Titles for Select Computer Engineering Occupations in South Carolina and North Carolina

Job Title	Total/Unique (Jan 2018 - Sep 2018)	Posting Intensity	Median Posting Duration
Design Engineers (Architecture and Engineering)	276 / 77	4 : 1	35 days
Senior Electrical Engineers	319 / 58	6 : 1	38 days
Systems Engineers (Architecture and Engineering)	84 / 27	3 : 1	30 days
Controls Engineers	124 / 25	5 : 1	32 days
Product Engineers	68 / 20	3 : 1	17 days
Electronics Engineers	98 / 18	5 : 1	65 days
Power Systems Engineers	45 / 18	3 : 1	35 days
Signal Processing Engineers	99 / 18	6 : 1	33 days
Radio Frequency Engineers	152 / 17	9 : 1	55 days
Staff Engineers	46 / 15	3 : 1	41 days

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Figure 9 illustrates the top hard skills among job postings in South Carolina and North Carolina from January to September 2018 for select computer engineering occupations that require a master's degree. There is some variation between some of the hard skills employers are looking for and the skills that the workforce highlights in its online résumés and profiles. Computer engineering had the biggest difference, being mentioned in 54% of job posts but only 26% of workforce profiles. Other disconnects include computer control systems (15% of postings vs. 7% of profiles), automation (19% of postings and 12% of profiles), and systems design (13% of postings and 8% of profiles). It is important to note that skills associated with workforce profiles represent all education and experience levels, which could explain part of the discrepancy between job postings and workforce profiles.

Figure 9: Top Hard Skills for Select Computer Engineering Occupations in South Carolina and North Carolina

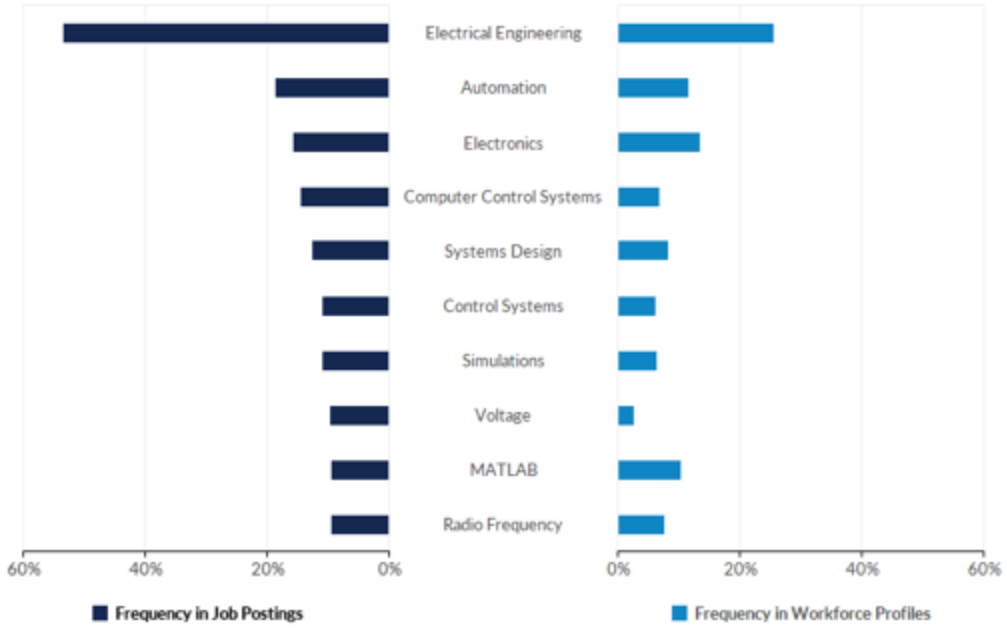

Figure 10 on the following page highlights the top companies in South Carolina and North Carolina from January to September 2018 with job postings for select computer engineering occupations that require a master's degree. Duke Energy Corporation had the highest number of unique offerings (75), followed by Eaton Corporation (36) and ABB LTD. (28). Leidos Holdings and Aerotek tied for the highest posting intensity ratio at 10:1, again indicating that these companies are putting in above average effort toward filling their openings.

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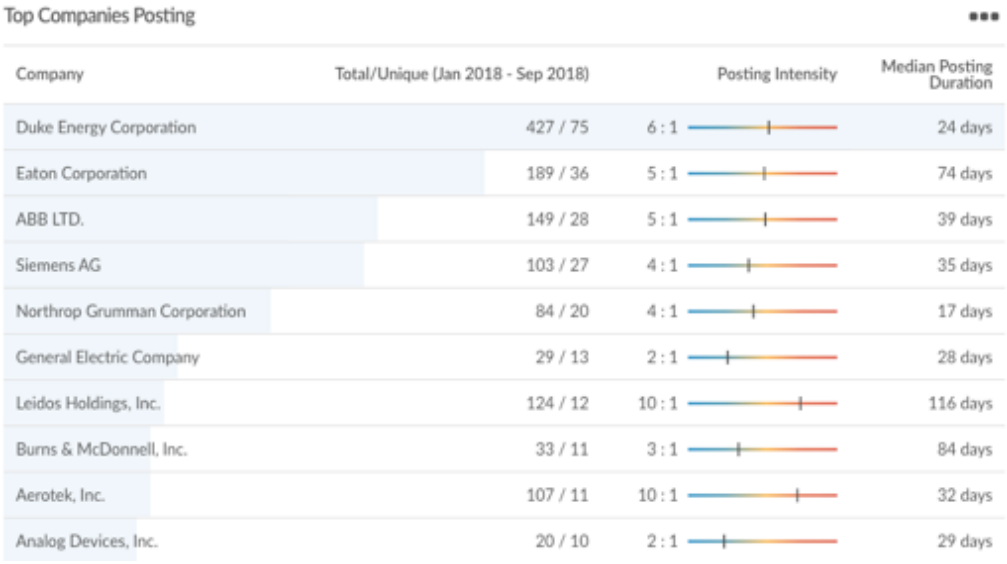
Figure 10: Top Companies with Job Postings for Select Computer Engineering Occupations In South Carolina North Carolina



Southeast (Secondary Region)

The third section of the occupational analysis examines historical and forecasted data for select computer engineering occupations in the Southeast. Table 7 details historical demand. From 2008 to 2018, Computer engineers experienced a substantial growth rate of 20%. Electronics engineers experienced negative growth over that period, losing 5% of jobs.

Table 7: Historical Demand for Select Computer Engineering Occupations in the Southeast

Occupation	Jobs		Change		Annual Openings
	2008	2018	#	%	
Computer Engineers	32,480	38,839	6,359	20%	3,553
Electronics Engineer, Except Computer	28,616	27,108	(1,508)	(5%)	2,458
	61,096	65,947	4,851	8%	6,011

Table 8 highlights the projected future demand for select computer engineering occupations in the Southeast. From 2018 to 2028, Computer engineers are projected to experience 14% growth, while electronics engineers are also projected to see positive growth of 8%. The median salary for electronics engineers is approximately $4,000 more than Computer engineers.

Table 8: Future Demand for Select Computer Engineering Occupations in the Southeast

Occupation	Jobs		Change		Annual Openings	Median Salary
	2018	2028	#	%		
Computer Engineers	38,839	44,233	5,394	14%	3,209	$89,211
Electronics Engineer, Except Computer	27,108	29,234	2,126	8%	2,050	$93,808
	65,947	73,467	7,520	11%	5,259	$91,100

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Table 9 examines the projected demand for master's degrees in select computer engineering occupations in the Southeast. It is expected that there will be 4,413 annual replacement job openings due to workers leaving the occupation. Applying the same rationale as for the local region (see Table 3), 24.1% or 1,064 of those individuals should have a master's degree and the openings will likely be filled by someone with a master's degree

Table 9: Projected Demand for Master's Degrees in Select Computer Engineering Occupations in the Southeast

Occupation	National Educational Attainment (2018)		Annual Replacement Jobs	Master's Needing Replaced Annually
	% with a Master's	% with a Bachelor's		
Select Computer Engineering Occupations	24.1%	49.3%	4,413	1,064

Figure 11 highlights job postings in the Southeast from January to September 2018 for select Computer engineering occupations that require a master's degree. There were 4,031 unique postings which were posted a total of 30,155 times, a posting intensity ratio of 7:1, above the regional average for all occupations (4:1), which suggests that companies in the region are putting above average effort into hiring for these positions.

Figure 11: Job Postings for Select Computer Engineering Occupations in the Southeast

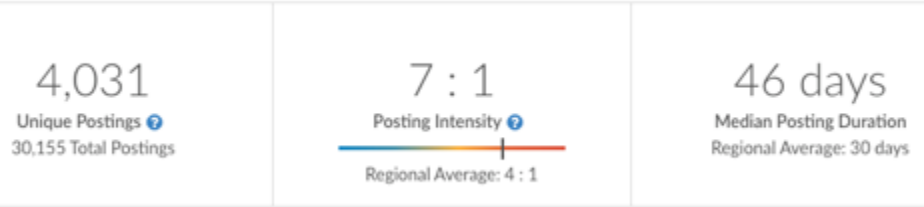

Figure 12 on the following page illustrates the top 10 cities in the Southeast with job postings from January to September 2018 for select computer engineering occupations that require a master's degree. During that time, Huntsville, AL, had 346 unique postings, the most of any city, followed by Chantilly, VA (211), and Charlotte, NC (193). Both Huntsville and Orlando had the highest posting intensity ratio (10:1), which suggests employers in those cities are trying to fill their openings more aggressively.

Figure 12: Top Cities with Job Postings for Select Computer Engineering Occupations in the Southeast

City	Total/Unique (Jan 2018 - Sep 2018)	Posting Intensity	Median Posting Duration
Huntsville, AL	3,557 / 346	10 : 1	58 days
Chantilly, VA	1,953 / 211	9 : 1	58 days
Raleigh, NC	981 / 193	5 : 1	48 days
Orlando, FL	1,842 / 179	10 : 1	69 days
Atlanta, GA	889 / 159	6 : 1	58 days
Melbourne, FL	976 / 112	9 : 1	47 days

Some data hidden

Figure 13 details job titles among job postings in the Southeast from January to September 2018 for select Computer engineering occupations that require a master's degree. Senior computer engineer was the most common job title with 467 unique posts, followed by design engineers (architecture and engineering) at 383 and systems engineers (architecture and engineering) at 27. Systems engineers (architecture and engineering) had a very high posting intensity ratio of 14:1.

Figure 13: Top Job Titles for Select Computer Engineering Occupations in the Southeast

Job Title	Total/Unique (Jan 2018 - Sep 2018)	Posting Intensity	Median Posting Duration
Senior Electrical Engineers	3,606 / 467	8 : 1	49 days
Design Engineers (Architecture and Engineering)	3,150 / 383	8 : 1	47 days
Systems Engineers (Architecture and Engineering)	3,705 / 263	14 : 1	46 days
Radio Frequency Engineers	1,130 / 181	6 : 1	65 days
Controls Engineers	1,238 / 178	7 : 1	38 days
Power Systems Engineers	755 / 147	5 : 1	33 days
Systems Engineers (Computer and Mathematical)	775 / 141	5 : 1	42 days
Electronics Engineers	693 / 101	7 : 1	48 days
Signal Processing Engineers	1,039 / 98	11 : 1	80 days
Entry Level Electrical Engineers	472 / 76	6 : 1	38 days

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Figure 14 illustrates the top hard skills among job postings in the Southeast from January to September 2018 for select computer engineering occupations that require a master's degree. Here again, there is some variation between some of the hard skills employers are looking for and their frequency in workforce profiles. Computer engineering had the biggest difference, being mentioned in 53% of job posts, but only 29% of workforce profiles. Other disconnects include systems engineering (23% of postings vs. 12% of profiles), simulations (14% of postings and 5% of profiles), and sensitive compartmented information or SCI clearance (12% of postings and none in profiles). It is important to note that skills associated with workforce profiles represent all education and experience levels, which could explain part of the discrepancy between job postings and workforce profiles.

Figure 14: Top Hard Skills for Select Computer Engineering Occupations in the Southeast

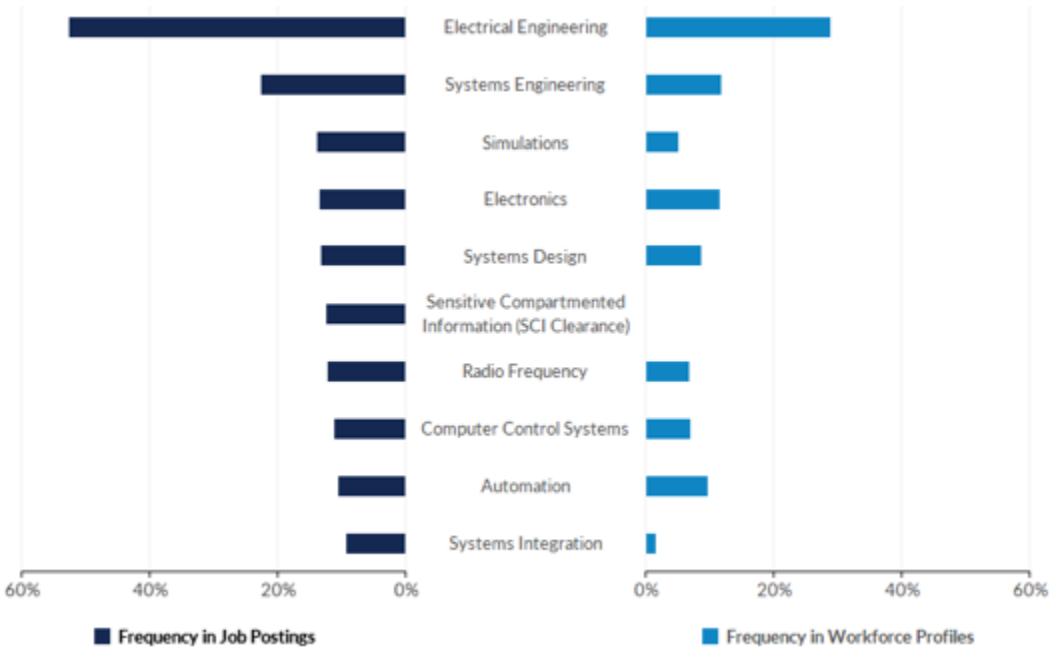

Figure 15 on the following page highlights the top companies with job postings in the Southeast from January to September 2018 for select Computer engineering occupations that require a master's degree. Northrop Grumman Corporation had the highest number of unique offerings (168), followed by Leidos Holdings Inc. (158) and General Electric Company (150). General Dynamics Corporation had, by far, the highest posting intensity ratio at 38:1, which indicates that the company is putting significantly more effort toward filling their openings.

Figure 15: Top Companies with Job Postings for Select Computer Engineering Occupations in the Southeast

Company	Total/Unique (Jan 2018 - Sep 2018)	Posting Intensity	Median Posting Duration
Northrop Grumman Corporation	1,354 / 168	8 : 1	53 days
Leidos Holdings, Inc.	1,766 / 158	11 : 1	74 days
General Electric Company	322 / 150	2 : 1	27 days
The Boeing Company	1,667 / 135	12 : 1	37 days
Science Applications International Corporation	873 / 113	8 : 1	49 days
Duke Energy Corporation	594 / 110	5 : 1	18 days
General Dynamics Corporation	2,805 / 74	38 : 1	9 days
Eaton Corporation	299 / 66	5 : 1	69 days
Harris Corporation	1,198 / 65	18 : 1	69 days
Lockheed Martin Corporation	955 / 59	16 : 1	87 days

United States (Tertiary Region)

The fourth and final section of the occupational analysis examines historical and forecasted data for select Computer engineering occupations in the United States. Table 10 details demand for select Computer engineering occupations in the United States. From 2008 to 2018, Computer engineers experienced a substantial growth rate of 20%, while electronics engineers saw a 4% decrease in jobs.

Table 10: Historical Demand for Select Computer Engineering Occupations in the United States

Occupation	Jobs		Change		Annual Openings
	2008	2018	#	%	
Computer Engineers	163,691	196,053	32,362	20%	17,206
Electronics Engineer, Except Computer	152,098	146,069	(6,029)	(4%)	12,419
	315,789	342,122	26,333	8%	29,625

Table 11 highlights the projected future demand for select Computer engineering occupations in the United States. From 2018 to 2028, Computer engineers are projected to experience 10% growth, and electronics engineers 5%. The average median salary is $96,013.

Table 11: Future Demand for Select Computer Engineering Occupations in the United States

Occupation	Jobs		Change		Annual Openings	Median Salary
	2018	2028	#	%		
Computer Engineers	196,053	216,453	20,400	10%	15,252	$93,038
Electronics Engineer, Except Computer	146,069	153,095	7,026	5%	10,484	$100,006
	342,122	369,548	27,426	8%	25,736	$96,013

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Table 12 details relevant employment information for the top 30 MSAs employing select Computer engineering occupations in the United States. Among the highlighted MSAs, the Los Angeles MSA currently employs the highest number of computer engineering occupations (17,775), followed by the New York City MSA (13,928), and the Dallas-Fort Worth MSA (11,799). The Charlotte MSA is tied with the Miami MSA for the strongest forecasted percentage growth at 17%.

Table 12: Top 30 MSA's of Employment for Select Computer Engineering Occupations in the United States

MSA	Jobs		Change (2018–2028)		Annual Openings	Median Salary
	2018	2028	#	%		
Los Angeles-Long Beach-Anaheim, CA	17,775	17,158	(617)	(3%)	1,116	$111,816
New York-Newark-Jersey City, NY-NJ-PA	13,928	14,939	1,011	7%	1,056	$99,271
Dallas-Fort Worth-Arlington, TX	11,799	12,858	1,059	9%	897	$102,642
San José-Sunnyvale-Santa Clara, CA	11,632	11,281	(351)	(3%)	728	$124,794
Boston-Cambridge-Newton, MA-NH	10,539	11,169	630	6%	762	$113,798
San Diego-Carlsbad, CA	9,580	10,117	537	6%	676	$114,563
Washington-Arlington-Alexandria, DC-VA-MD-WV	9,330	9,619	289	3%	649	$118,038
Detroit-Warren-Dearborn, MI	8,899	9,646	747	8%	675	$87,346
Chicago-Naperville-Elgin, IL-IN-WI	7,435	7,704	269	4%	523	$91,690
Seattle-Tacoma-Bellevue, WA	7,377	7,655	278	4%	502	$113,725
San Francisco-Oakland-Hayward, CA	7,291	8,292	1,001	14%	594	$110,653
Phoenix-Mesa-Scottsdale, AZ	6,977	7,207	230	3%	482	$87,929
Houston-The Woodlands-Sugar Land, TX	6,959	7,464	505	7%	505	$100,301
Atlanta-Sandy Springs-Roswell, GA	6,534	7,022	488	7%	486	$90,280
Denver-Aurora-Lakewood, CO	6,523	7,169	646	10%	500	$89,974
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	6,025	6,304	279	5%	423	$96,200
Portland-Vancouver-Hillsboro, OR-WA	4,911	5,286	375	8%	360	$90,244
Baltimore-Columbia-Towson, MD	4,861	5,119	258	5%	346	$108,697
Minneapolis-St. Paul-Bloomington, MN-WI	4,748	5,062	314	7%	345	$94,097
Austin-Round Rock, TX	4,723	5,391	668	14%	387	$113,461
Kansas City, MO-KS	3,795	4,154	359	9%	295	$88,282
Huntsville, AL	3,200	3,538	338	11%	247	$104,761
Charlotte, NC	**3,197**	**3,745**	**548**	**17%**	**276**	**$106,141**
St. Louis, MO-IL	3,191	3,292	101	3%	219	$98,332
Pittsburgh, PA	2,961	3,137	176	6%	212	$91,835
Virginia Beach-Norfolk-Newport News, VA-NC	2,600	2,805	205	8%	192	$86,911
Miami-Fort Lauderdale-West Palm Beach, FL	2,541	2,961	420	17%	216	$76,923
Sacramento--Roseville--Arden-Arcade, CA	2,490	2,685	195	8%	184	$108,418
Tucson, AZ	2,424	2,493	69	3%	162	$106,907
Albuquerque, NM	2,229	2,203	(26)	(1%)	146	$107,203

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Table 13 examines the projected demand for master's degrees in select computer engineering occupations in the United States. It is expected that there will be 22,488 annual replacement job openings due to workers leaving the occupation. Applying the same rationale as for the local region (see Table 3), 24.1% or 5,420 of those individuals should have a master's degree and the openings will likely be filled by someone with a master's degree.

Table 13: Projected Demand for Master's Degrees in Select Computer Engineering Occupations in the United States

Occupation	National Educational Attainment (2018)		Annual Replacement Jobs	Master's Needing Replaced Annually
	% with a Master's	% with a Bachelor's		
Select Computer Engineering Occupations	24.1%	49.3%	22,488	5,420

Figure 16 highlights national job postings from January to September 2018 for select computer engineering occupations that require a master's degree. There were 21,351 unique postings which were posted a total of 145,987 times, resulting in a posting intensity ratio of 7:1, above the national average for all occupations (4:1).

Figure 16: Job Postings for Select Computer Engineering Occupations in the United States

Figure 17 on the following page lists the top 10 cities in the U.S. with job postings from January to September 2018 for select computer engineering occupations that require a master's degree. San Diego, CA, had the most unique posting (690), followed by El Segundo, CA (453), and San Jose, CA (376). El Segundo, CA, Huntsville, AL, and Austin, TX, tied for the highest posting intensity ratio (10:1).

Figure 17: Top Cities with Job Posting for Select Computer Engineering Occupations in the United States

City	Total/Unique (Jan 2018 - Sep 2018)	Posting Intensity	Median Posting Duration
San Diego, CA	5,442 / 690	8 : 1	61 days
El Segundo, CA	4,733 / 453	10 : 1	65 days
San Jose, CA	1,990 / 376	5 : 1	55 days
Huntsville, AL	3,557 / 346	10 : 1	58 days
Austin, TX	2,824 / 284	10 : 1	56 days
Santa Clara, CA	1,260 / 281	4 : 1	55 days
Houston, TX	1,333 / 213	6 : 1	43 days
Chantilly, VA	1,953 / 211	9 : 1	58 days
Sunnyvale, CA	1,335 / 209	6 : 1	62 days
Washington, DC	1,239 / 205	6 : 1	37 days

Figure 18 details job titles among national job postings from January to September 2018 for select Computer engineering occupations that require a master's degree. Design engineers (architecture and engineering) was the most common job title with 2,951 unique posts, followed by senior computer engineers with 1,939 and systems engineers (architecture and engineering) 1,194. Systems engineers (architecture and engineering) and electronics engineers tied for the highest posting intensity ratio of 8:1.

Figure 18: Top Job Titles for Select Computer Engineering Occupations in the United States

Job Title	Total/Unique (Jan 2018 - Sep 2018)	Posting Intensity	Median Posting Duration
Design Engineers (Architecture and Engineering)	20,500 / 2,951	7 : 1	47 days
Senior Electrical Engineers	14,114 / 1,939	7 : 1	50 days
Systems Engineers (Architecture and Engineering)	10,092 / 1,194	8 : 1	51 days
Radio Frequency Engineers	7,402 / 1,012	7 : 1	52 days
Controls Engineers	6,047 / 892	7 : 1	42 days
Electronics Engineers	5,762 / 751	8 : 1	44 days
Power Systems Engineers	4,115 / 726	6 : 1	40 days
Systems Engineers (Computer and Mathematical)	3,630 / 543	7 : 1	55 days
Product Engineers	2,399 / 400	6 : 1	33 days
Staff Engineers	1,664 / 385	4 : 1	46 days

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Figure 19 illustrates the top hard skills among job postings nationally from January to September 2018 for select Computer engineering occupations that require a master's degree. Again, there is a difference in the frequency in job postings of some of the hard skills that employers are looking for and in workforce profiles. Computer engineering had the biggest difference, being mentioned in 56% of job posts but only 30% of workforce profiles. Other disconnects include simulations (19% of postings and 8% of profiles), electronics (18% of postings and 13% of profiles), and radio frequency (14% of postings and 8% of profiles). Additionally, while 14% of the workforce includes MATLAB in its profile, only 12% of job postings mention it. It is important to note that skills associated with workforce profiles represent all education and experience levels, which could explain part of the discrepancy between job postings and workforce profiles.

Figure 19: Top Hard Skills for Select Computer Engineering Occupations in the United States

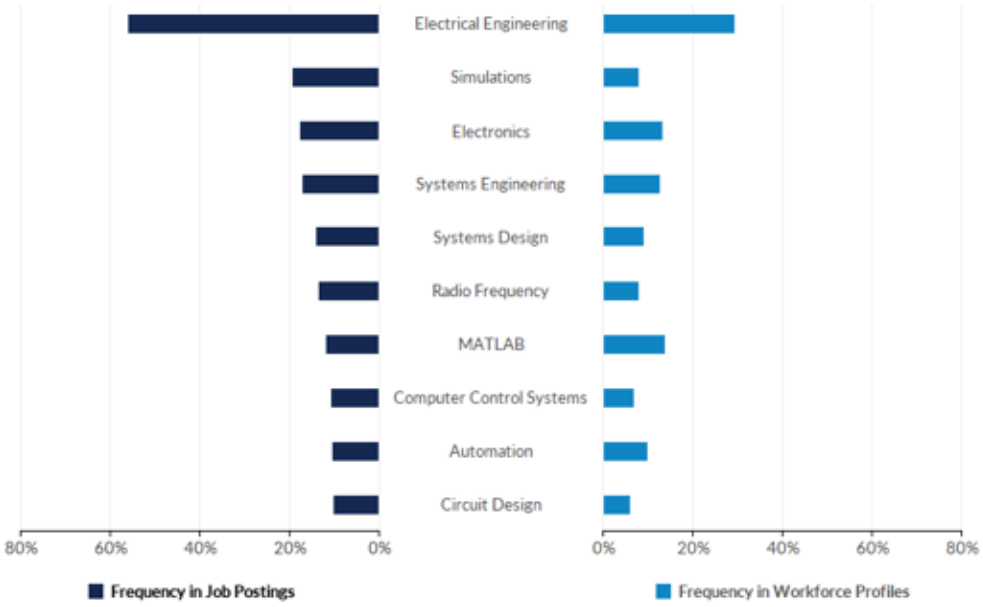

Figure 20 on the following page highlights the top national companies with job postings from January to September 2018 for select computer engineering occupations that require a master's degree. Northrop Grumman Corporation had the highest number of unique offerings (1,004), followed by General Electric Company (772) and The Boeing Company (611). General Dynamics Corporation had the highest posting intensity ratio at 18:1, which indicates that the company is putting significantly more effort toward filling their openings than other companies in the field.

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Figure 20: Top Companies with Job Postings for Select Computer Engineering Occupations in the United States

Top Companies Posting

Company	Total/Unique (Jan 2018 - Sep 2018)	Posting Intensity	Median Posting Duration
Northrop Grumman Corporation	9,638 / 1,004	10 : 1	58 days
General Electric Company	2,218 / 772	3 : 1	28 days
The Boeing Company	6,187 / 611	10 : 1	34 days
Raytheon Company	4,159 / 449	9 : 1	90 days
Lockheed Martin Corporation	3,420 / 371	9 : 1	75 days
Leidos Holdings, Inc.	3,993 / 359	11 : 1	69 days
BAE SYSTEMS PLC	1,584 / 299	5 : 1	58 days
Eaton Corporation	1,535 / 294	5 : 1	71 days
General Dynamics Corporation	4,796 / 269	18 : 1	9 days
Burns & McDonnell, Inc.	972 / 244	4 : 1	82 days

VIII. Competitive Analysis

The programs featured in the competitive analysis do not constitute an exhaustive list of competitors, but rather provide an overall representation of the current marketplace. Because some tuition costs are often estimated and do not include additional fees, the tuition prices should be used more as guidelines rather than definitive bounds. For programs that do not post a set per-credit cost for a program, a per-credit rate was calculated by taking a semester's tuition rate and dividing it by 12 credits. Completions data (the number of students who completed a master's degree in Computer Engineering since 2017) from Economic Modeling Specialists International (EMSI) was used to represent the size of each program. While many of the profiled programs are not identical to the SC State program, they feature key elements of the program or prioritize many of the professional titles that the SC State program pursues. Additional information about each competing program is available in Appendix I.

Table 14 lists three institutions in North Carolina and South Carolina that could compete with the SC State program. All are 30 credits and cost an average of $27,210 for North Carolina residents.

Table 14: Potential Competitors—North Carolina and South Carolina

Institution	Program Name	*US News* Ranking[11]		Delivery	Length	Total Program Cost		Require GRE? Minimum Score?
		Computer Eng.	Eng. School			In-State	Out-of-State	
Duke University	Master of Engineering (MEng) in Computer Engineering	25	26	On-Campus	30 Credits	$65,610		Yes, but no minimum. Typically, mid 50%
North Carolina A&T State University	Master of Science in Computer Engineering	144	Rank not Published (RNP)	On-Campus	30 Credits	$7,890	$28,980	Verbal + Quantitative = 1100
North Carolina State University	Master of Science in Computer Engineering	89	Rank not Published (RNP)	On-Campus	30 Credits	$9,890	$21,980	
University of North Carolina at Charlotte	Master of Science in Computer Engineering (M.S.E.E.)	96	145	On-Campus	30 Credits	$8,130	$33,330	Verbal: 153.0 Quant: 155.0 [12]
University of South Carolina	Master of Science in Computer Engineering	110	97	On-Campus	24	$7,500	$31,500	Verbal + Quant: 1000

[11] US News Electrical Engineering programs rank is for graduate schools with an electrical/electronic/communications engineering program. The engineering school column is the rank of graduate engineering schools.
[12] This is an expected score, not an explicit minimum.

Table 15 lists five institutions in the southeastern United States that could compete with the SC State program. The programs range from 30 to 33 credits and program costs range from $13,440 to $28,334 for in-state students. All of the schools require students to take the GRE; however, only two require a minimum score.

Table 15: Potential Competitors—Southeastern United States

Institution	Program Name	*US News* Ranking[13]		Delivery	Length	Total Program Cost		Require GRE? Minimum Score?
		Computer Eng.	Eng. School			In-State	Out-of-State	
Georgia Institute of Technology	Master of Science in Computer Engineering	5	8	Online and On-Campus	30 Credits	$17,640		Verbal: 146 Quant: 155 Writing: 3.5
Virginia Tech	MEng in Computer Engineering	18	T30	Online and On-Campus	32 Credits	$26,176	$51,040	Verbal: 153.0 Quant: 157.0 Writing: 4.5
University of Virginia	MEng and Master of Science in Computer Engineering	39	40	Online and On-Campus	31 Credits	$28,334	$46,872	Yes but no minimum
University of Florida	MEng and Master of Science in Computer Engineering	32	T43	Online and On-Campus	30 Credits	$13,440	$20,700	Yes, but no minimum
Auburn University	Master of Science in Computer Engineering	T59	T75	Online and On-Campus	33 Credits	$18,725	$52,965	Yes, but no minimum

[13] US News Electrical Engineering programs rank is for graduate schools with an electrical/electronic/communications engineering program. The engineering school column is the rank of graduate engineering schools.

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Table 16 lists 11 national institutions that could compete with the SC State program. The programs range from 21 to 45 credits and cost from $24,900 to $60,840 for in-state students. Nine of the schools require students to take the GRE; however, only the University of Michigan has a minimum score requirement.

Table 16: Potential Competitors—National

Institution	Program Name	*US News* Ranking[14]		Delivery	Length	Total Program Cost		Require GRE? Minimum Score?
		Computer Eng.	Eng. School			In-State	Out-of-State	
Stanford University	Master of Science in Computer Engineering	T1	2	Online and On-Campus	45 Credits	$60,840		Typically, in the 90th percentile, but no minimum
Purdue University—West Lafayette	Master of Science in Computer Engineering	T9	7	Online and On-Campus	30 Credit	$34,170	$39,060	Yes, but no minimum
University of Texas—Austin (Cockrell)	Master of Science in Computer Engineering	T9	T10	Online and On-Campus	21 Credit	$29,421	$41,874	Yes, but no minimum
University of Michigan—Ann Arbor	Master of Science in Computer Engineering	7	T4	Online and On-Campus	30 Credit	$44,250	$48,630	Yes, with scores in the 50th percentile or higher
University of Southern California	Master of Science in Computer Engineering	T13	T10	Online and On-Campus	28 Credits	$56,140		Yes, but no minimum
Columbia University	Master of Science in Computer Engineering	T15	T12	Online and On-Campus	30 Credit	$60,540		Yes, but no minimum
Johns Hopkins University	Master of Science in Computer Engineering	T21	T18	Online and On-Campus	30 Credits	$53,730		Yes, but no minimum
University of Minnesota—Twin Cities	Master of Science in Computer Engineering	T25	28	Online	30 Credits	$42,660		Yes
University of Colorado Boulder	Master of Engineering in Computer Engineering	T35	32	Online and On-Campus	30 Credits	$24,900		No
The Pennsylvania State University	Master of Engineering in Computer Engineering	T30	T33	Online and On-Campus	30 Credits	$27,900		No
Arizona State University	Master of Science in Engineering in Computer Engineering	32	T45	Online	30 Credits	$29,970		Yes, but no minimum

[14] US News Electrical Engineering programs rank is for graduate schools with an electrical/electronic/communications engineering program. The engineering school column is the rank of graduate engineering schools.

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Table 17 displays completion data for the 16 competing institutions identified with online offerings from 2013 to 2017 and their Computer and electronics engineering program (CIP 14.1001). Only distance offered completions are displayed. Distance offered program completions are defined as "a program for which all the required coursework is able to be completed via distance education courses. All completions of this program are considered distance offered completions, even if some students chose not to enroll in distance education courses."[15] This means that if there are 10 distance offered completions, and four of these were completed online and six completed on-campus, all 10 would be counted as distance offered completions. Completions Data is taken directly from the national IPEDS database published by the U.S. Department of Education's National Center for Education Statistics.

From 2013 to 2017, the University of Southern California had the highest number of completions (2,363), followed by Georgia Institute of Technology (1,754), and Arizona State University (1,339). Many of the institutions showed wide year-to-year variation, but overall, the annual totals have remained fairly constant.

Table 17: Completion Data for Competing Institutions from 2013 to 2017

Institution	Completions					
	2013	2014	2015	2016	2017	Total
University of Southern California	387	470	**599**	461	446	2,363
Georgia Institute of Technology	290	335	334	**457**	338	1,754
Arizona State University	263	288	**359**	257	172	1,339
Stanford University	**249**	180	209	197	167	1,002
University of Florida	197	219	117	176	**231**	940
Columbia University	**206**	168	196	196	192	958
University of Texas--Austin (Cockrell)	118	120	113	116	**140**	607
Johns Hopkins University	129	**150**	96	98	141	614
University of Michigan--Ann Arbor	**241**	199	180	122	97	839
University of Minnesota-Twin Cities	121	110	124	118	**139**	612
North Carolina State University	96	113	124	110	**130**	573
Purdue University--West Lafayette	74	85	140	**128**	115	542
University of Colorado Boulder	75	**82**	59	70	90	376
Virginia Tech	66	53	69	54	**72**	314
Pennsylvania State University	37	36	**48**	36	46	203
Auburn University	21	57	**61**	49	39	227
University of Virginia	11	10	17	9	**29**	76
Total	2,581	2,675	2,845	2,654	2,584	13,339

[15] https://www.economicmodeling.com/2017/11/20/emsi-introduces-data-related-distance-offered-academic-programs/

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IX. Opinion Leader Analysis

The University Professional and Continuing Education Association and its Center for Research and Strategy conducted interviews with eight professionals throughout the United States who hold leadership positions in the Computer engineering field. This section includes a summary of these interviews, including relevant quotations and analysis.

Market Overview

Industry Trends: Interview participants were asked what are the most important current or developing trends as they relate to those seeking a career as a computer engineer. Key takeaways include:

- Trends in the field include renewable and solar energy developments, mentioned by two individuals. These center around various applications within the field of solar energy, and specifically in the photovoltaic sector. One individual mentioned the electric vehicle aspect of renewable energy, and the project of building and maintaining charging stations everywhere.

- Other trends mentioned include artificial intelligence, quantum computing, wireless, and the Internet of Things (IoT), in addition to smart cities and smart networks.

- Another trend was described by one opinion leader as critical systems and data centers in general. The opinion leader mentioned that there is a great deal of communication and collaboration between Computer engineers and the technicians who design some of these systems.

> "I'd say the biggest and fastest advancing thing that I deal with on a regular basis, and I work in the macro field in building design, is critical systems, UPS's (Uninterruptable Power Supply), and things of that nature with data centers. They're constantly upgrading. And another thing, ancillary to that, is it seems like the technicians who work for some of these bigger banks and Facebook, and these kinds of entities, they're getting very, very savvy in how they design their systems to do a lot of it."
> - *Computer Designer, Computer Engineering Firm*

- One opinion leader mentioned that they work in buildings and construction, and believe it is important for graduates to be familiar with are various codes for different institutions and facilities. This area is changing often, and graduates must keep current.

- One individual admitted being somewhat far from the latest trends, but being from the power industry, felt that relaying equipment, and especially its involvement with communication, is something that is being seen everywhere. This respondent gave new SEL Controllers as an example.

"…As engineers, we have both a technical (understanding) and an understanding of the physics of the base, but we've also got the practical application of how to handle it. We need some hands on and understanding. Now, I don't know where all these various components should come in. Some are definitely on the job training kinds of things, and others ought to be addressed in the classroom to some degree. That would be my outline."

- *Computer Engineer, Engineering Consultant Firm*

"As far as things that are in my field, we work in power, and I guess the things that are the most exciting and really eye catching, the things that you're going to see at conferences, is the relaying equipment. It's been really interesting, in the power industry, with communications and relaying, and it's been cool. But I'm not the best expert on that, but that's kind of what I've been hearing and what most people talk about around the office and guys I listen to. They're checking out new SEL controllers and things like that."

- Project Engineer, Computer Engineering Consulting Company

"Renewable energy is still going strong. We're getting a lot of movement in PV (Photovoltaic) installations. There's also a move towards micro-grid applications, trying to take these renewable sources that we're designing and use them separate from the utility, whenever possible.

- Computer Engineer, Engineering Consultant Firm

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Industry Needs: Interview participants were asked to describe the supply and quality of computer engineers. Important takeaways include:

- Almost all described a shortage in the field, with many openings to be filled.
- One individual mentioned that they have turned towards hiring from a global market to try to find the best candidates, but that there are several VISA issues they have encountered.
- Several opinion leaders frequently see many open job positions and that it can be very hard to find qualified people to fill them.
- Several leaders mentioned that while candidates can be hard to find, once they are found, they are often of high quality.

"Scarce. I would hire one today if I could find them. We just don't have the young folks, we don't have the people that are willing to go the extra mile for engineering. I'm sure the dropout rate today is about what it was when I came through."

- *Computer Engineer, Engineering Consultant Firm*

"Sure, there are a lot of jobs right now. It's very hard to actually get people. I would say the majority of the applicants are good, if you can get them. It's kind of hard to find one, and some do come across our desk that just aren't qualified. There's just not enough. The volume is not there."

- *Computer Engineer, Engineering Firm*

- One opinion leader reported that they don't have as much trouble finding good engineering talent, but it has gotten expensive to pay them the salaries that they expect.
- It was also reported that interns that come in are often very knowledgeable and better trained to handle the work that they're given. This leader described the quality of interns as high, with their having good backgrounds in circuits, electromagnetic theory, and a strong engineering mindset.

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Job Titles Looking to Fill: Interview participants were asked what are the job titles of professionals they are hiring or positions they are looking to fill that require knowledge and expertise in computer engineering. The positions mentioned include:

- Computer Engineers (4 mentions)
- Computer Designers (2 mentions)
- Substation Engineers
- Quality Engineers
- Manufacturing Engineers
- Project Engineers
- Senior Engineers

Specific Skills: Interview participants were asked to describe the skills professionals should possess in order to be successful in the Computer engineering field. Key takeaways include:

- Two stressed the importance of having a strong base in mathematics and physics. Students should focus on this during their studies because so much of what they do in the rest of their careers uses these courses as building blocks.

- Two respondents also mentioned the importance of having good time management skills.

> "So, as far as where computer engineers are needed, and where they really shine, relaying and protection. You're dealing with microelectronics, you're dealing with complex numbers, things that mechanical (engineers) and civil (engineers) don't get their hands dirty with. Some electrical (engineers) do, but as far as the hardcore theory of what's going on, the electrical (engineers) are the dominant force in there. Substation engineers, we do take electrical (engineers), but so much of it is structural, so civil (engineers) do really well. But the substation engineers that are electrical, they do well in the sense that they understand the electrical forces at work on the structures and why you need certain equipment in there and why you would choose certain circuit breakers or certain transformers over another one… So, substation (engineers) in our area really shine. I would say those are the two biggest areas where electrical engineers do really well, in particular."
>
> - *Project Engineer, Engineering Consulting Firm*

- Several other technical or hard skills that were identified include Computer theory, graphic arts skills, familiarity with various software programs, and knowing building and construction codes and regulations.

- Other soft skills that were listed as being most important for Computer engineers include perseverance, patience, good communication and soft skills, attention to detail, and for individuals to be curious.

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- Another opinion leader indicated the importance of gaining hands-on experience in the work field through internships or work experiences.

"What you really want to do is see that you have somebody who, today, can do what you need and 5 years from now still do new things that he has not taken classes in but can learn. So, fundamentally, you have to have a candidate who has the basic skills, the good foundation. And that's not necessarily taking a specific class in AI or some other hot topic today. To have the fundamental skills you basically need to be good at math and physics. Those are the two areas, and that's it. So, nothing has changed over the last 50 or 60 years of electrical engineering. You have to have the basic foundation and then you can learn anything you want."

- *Research Staff Member, Information Technology Company*

"But I would like to see a lot more software savvy [people]. Sadly, there are just thousands upon thousands of software out there nowadays for a myriad of different uses... and they grow by the day, but there are some basic ones. I've had interns who don't know how to use Auto CAD, and that seems pretty basic. Load flow analysis with software's like SKM or ETAP or things like that seem very basic and seem scalable to almost any level of engineering. So, that's one thing, I'd like to see a lot more software."

- *Computer Engineer, Computer Engineering Firm*

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Greatest Educational Needs: Interview participants were asked to describe the greatest educational needs for the computer engineering field pertaining to master's-level education. These include:

- Solar Technology (2 mentions)
- Business Side of Engineering (2 mentions)
- No Master's Degree Required for the Field (2 mentions)
- Control Theory
- Design Work, i.e., designing powers and mining layouts
- Familiarity with National Electric Code

"Because solar and renewables are becoming big and they are more in our culture, they are becoming more and more important, not just to the engineer but just to your average anybody. They know about solar and they know about wind. That kind of stuff is old news, and it's stuff that people are really trying to push. The big complication with solar, and with some of these renewables, and this is what we call distributed generation. It's basically your homeowner is now producing power, and how do we deal with that? A big problem is how do we protect the rest of the system if something goes array at that level with this new technology? So, really what we need to be tackling is understanding how we deal with renewables in the sense of protection and coordination."

- *Project Engineer, Engineering Consulting Firm*

"Well, a master's degree is almost overkill for what we do, to tell you the truth. For our sector of the industry, we're designing buildings that aren't that technically complex. If we were doing something towards designing a manufacturing plant, the working of the manufacturing equipment, there may be some specialties there. To be honest, you don't need a master's to do what we're doing."

- *Computer Engineer, Engineering Firm*

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Awareness of College and University Programs: Interview participants were asked if they were aware of any colleges and universities in the area offering strong master's degree programs in computer engineering. The programs identified include:

- University of Wisconsin-Madison, Madison, Wisconsin
  - The University of Wisconsin offers two Masters of Science in Computer Engineering degrees, including a research degree and a professional degree.

- Missouri University of Science and Technology (Missouri S&T), Rolla, Missouri
  - Missouri University of Science and Technology offers a Master of Science in Computer Engineering degree. "They have online master's programs. I know they offer it and I've looked at it for Computer engineering master's, and engineering management programs."
- UNC Chapel Hill
- NC State
- SC State (2 mentions)
  - "I was aware of SC State and I actually worked with an SC State grad for a year over here and he was talking about going back for the master's and doing some of it online. So, I was aware of that one."

"There is nothing wrong with online, and I'm sure you know that there are people who, for whatever reason, cannot be at the location where the university is. But if you're an experimentalist, meaning you have to build some kind of hardware as part of you learning, you really have to be in a lab, a physical lab. If your job is to write some program, perhaps that's less important. But I would also argue that, even in that case, there is some level of interaction with the group that is very important, too. I'm not saying it has to be every day to interact with colleagues in that group or people in sister groups, but without doing that you're missing something. So, I'm not against online, and I understand there are those cases where that's the only way to do it, but I would argue that in many cases you're missing quite a bit. I think in person, face to face, is important and I think if you're an experimentalist there's really a need for you to be physically in a lab where you have the equipment that you need. And it depends on what you're doing but being in a lab is a very important part of the training for a graduate degree."

- *Research Staff Member, Information Technology Company*

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Program Details

SC State's Reputation: Interview participants were asked, based on their experience in the field, what they know about SC State's reputation for computer engineering program. Key takeaways include:

- While one respondent reported being unsure or unfamiliar with the reputation of the university, all of the other respondents felt that the reputation of SC State would add to the strength of its program.
- The respondent who couldn't attest to the reputation of SC State said that it was because they were unfamiliar with the specific program in question.
- Individuals mentioned having family members and coworkers who attended SC State and that they were always top-quality employees.
- One individual from Charlotte mentioned that the university has a strong presence in their company, and they hire many graduates from SC State.
- One respondent who attended SC State for their undergraduate degree felt the university holds a strong reputation in the field. They have yet to encounter another engineer in their work experience who was better prepared than one from SC State.
- One individual mentioned that they had attended SC State, and classified SC State as the 'South Carolina Engineering guru's.' They also mentioned that their organization had an intern from SC State who was very smart and felt that the university is producing top-notch engineers.

"In the circles that I've run in, SC State is regarded as the premium for engineering degrees. So, I would assume that that would transfer over to the master's program as well. I know that a lot of schools have great engineering programs, but when I speak to people, they pretty much universally agree that SC State is the standard bearer for that."

- *Electrical Designer, Computer Engineering Firm*

"Almost everybody I work with is from SC State and they are really strong. We're in xxxxx, so it's a really strong presence here and I think, from what I see, they are all knowledgeable and have come out of school with good knowledge. I haven't run across anybody with a master's, though. It definitely is a good name here."

- *Computer Engineer, Engineering Firm*

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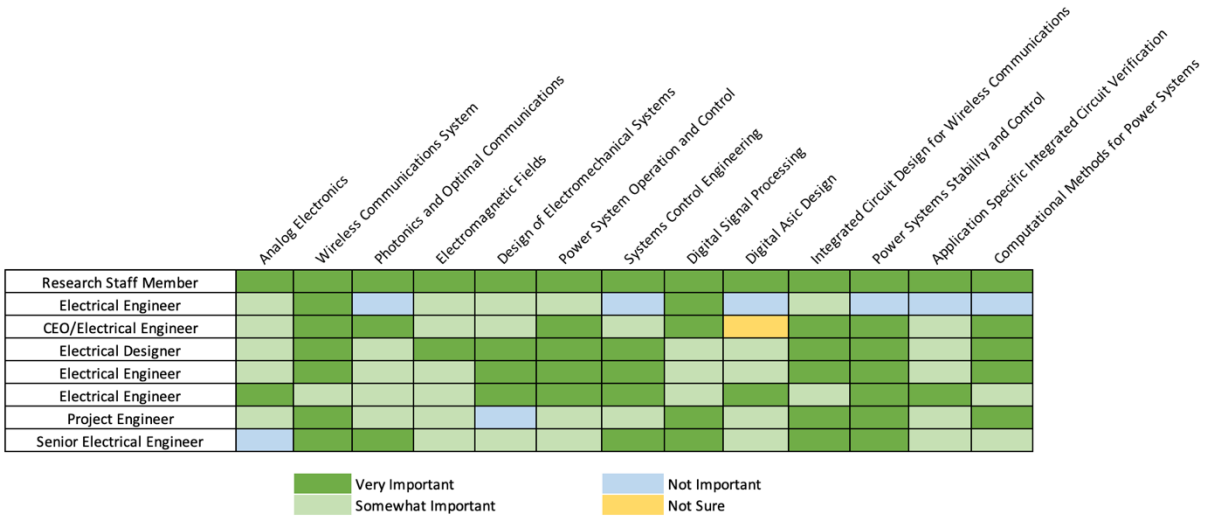
Potential Topics: Participants were asked how important the following 13 courses are for SC State's online master's degree in Computer engineering. The results are listed in the chart below:

Interview participants rated the value of the proposed topics in the following order:



1. Wireless Communications System (7 Very Important, 1 Somewhat Important)
2. Power Systems Stability and Control (7 Very Important, 1 Not Important)
3. Integrated Circuit Design for Wireless Communications (6 Very Important, 2 Somewhat Important)
4. Digital Signal Processing (5 Very Important, 3 Somewhat Important)
5. Power System Operation and Control (5 Very Important, 3 Somewhat Important)
6. Systems Control Engineering (5 Very Important, 2 Somewhat Important, 1 Not Important)
7. Computational Methods for Power Systems (5 Very Important, 2 Somewhat, 1 Not Important)
8. Design of Electromechanical Systems (4 Very Important, 3 Somewhat Important, 1 Not Important)
9. Photonics and Optical Communications (3 Very Important, 4 Somewhat Important, 1 Not Important)
10. Electromagnetic Fields (2 Very Important, 6 Somewhat Important)
11. Analog Electronics (2 Very Important, 5 Somewhat Important, 1 Not Important)
12. Application Specific Integrated Circuit Verification (2 Very Important, 5 Somewhat Important, 1 Not Important)
13. Digital ASIC Design (2 Very Important, 4 Somewhat Important, 1 Not Important, 1 Not Sure)

Interview participant quotes by topic:

Analog Electronics

"This is very important if you're going to be an engineer. Analog devices or work on things like radar or amplifiers and things of that sort. If you're going to be a digital signal processing engineer, you probably don't need too much of that. You can live a long life and be happy without this. So, it depends on what type of engineering career you're envisioning. But at some level, basic analog, understanding of analog devices and analog signals is definitely important. You don't have to be an expert, it depends what you're doing."

- *Research Staff Member, Information Technology Company*

Wireless Communications System

"Same thing again. I have colleagues here who are experts in their fields, world experts, and I'm sure they have no idea, or they have a very simplistic idea of wireless communications because they never do anything that has to do with wireless communications. They work on semiconductors and there is no wireless communication in that work. So, again, is it important? If you're in the communication area, absolutely, it's very important. But if you're doing basic physics of semiconductors, it probably doesn't matter so much. So, it depends, especially as you go into a graduate degree, there's more specializations, and you're choosing a path. In some paths this could be everything, and in other paths it's just general knowledge. "

- *Research Staff Member, Information Technology Company*

Photonics and Optimal Communications

"Hmm. Would photonics include area lighting? **Yes.** Very important, but Optimal Communications, not so much. Lighting in general is going to be huge."

- *Computer Engineer, Technology Company*

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Electromagnetic Fields

"Somewhat important, especially in power supply design. That is where you would want that the most."

- *Computer Engineer, Technology Company*

Digital Signal Processing

"I used to think of digital signal processing in terms of communication, but now it includes controls, electric motors and all kinds of things, so I'm going to say very important."

- *Computer Engineer, Engineering Consultant Firm*

Additional Course Topic Suggestions

- Strong Foundations in Math and Physics
  - "If you miss that part and you happen to know how to write a program that does some kind of machine learning, but you don't have the basic understanding of, for example, math, about optimization, and you don't really understand that the program you wrote is, in a general view, something that optimizes a function that does something, then you're not going to do very well, in my opinion. So, the basics is the key."
- Electromagnetic Compatibility and Electromagnetic Interference
  - "That's always a big part of designs nowadays. If you're developing new products of anything, it all has to go through that kind of testing, like regulatory testing. If you want to get the CE mark or UL mark."
- Engineering Management
  - "[Engineering Management] would help out a lot. We don't learn that stuff. As it relates to managing the workflow. If we take engineering management as undergrads, it's like project feasibilities, and things like that. Project management."
- Finance and Business
- Project Management

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Final Thoughts: Interview participants were asked to share any final thoughts they had about the proposed online Computer engineering program. Comments include:

"I would argue that for experimentalists it's important to be physically in a lab. I also mentioned that, even if you're non-experimental, the interaction with other colleagues who are doing their master's need discussions, whether it's over lunch or in group meetings, is also very important. You need to have some kind of interaction to do well. A program that is purely online is going to be missing these elements. Personally, if somebody was asking me, 'Should I take this program?', I would say, 'If you don't have any other options, yes, but it would not be my first choice.'"

- *Research Staff Member, Information Technology Company*

"Can I apply? From the sound of it, it's an excellent, excellent thing. Especially for someone in my shoes, I'm so old that I've forgotten a lot, but I've got a lot of experience and a much broader understanding than I ever had. So, I think I'm not ready for more learning, but to drop everything and go to school would be a challenge. I really think there's a need for it, and it would just be great."

- *Computer Engineer, Engineering Consultant Firm*

"If I had my druthers, of course I would definitely recommend myself or anyone to go to school in person, but I definitely do not look down upon online courses at all. I've gotten personal benefit out of them in the past and that's just the way the world is moving, to be quite honest. People looking for a master's often times are working full time jobs, they're older and they may have a family. So, there's incredible value there for people to be able to still continue their education while also living their adult lives, so to speak. And you also like the way this course was designed? You like this program and think it's pretty well-rounded? It sounds like it, yes. There are a few of the things, and I don't profess to know every single thing, but I think it sounded pretty good."

- *Computer Engineer, Electrical Engineering Firm*

"The one thing would be to get some project management in there. That's about it."

- *Computer Engineer, Engineering Firm*

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Appendix I

The following information is taken from each institution's respective website.

Potential South Carolina and North Carolina Competitors

Duke University—*Master of Engineering in Computer and Computer Engineering*

Duke's Master of Engineering in Computer and Computer Engineering offers its students an industry-focused alternative to a traditional master of science program, with a curriculum of eight graduate courses in Computer and computer engineering and two business and management courses. Students take specialized technical classes and a core of business leadership and management courses, with a required internship or a project completing the degree.

North Carolina A&T State University—*Master of Science in Computer Engineering*

The Master of Science in Computer Engineering emphasizes four areas of concentration: Computer Engineering; Communications and Signal Processing; Electronic and Optical Materials and Devices; and Power Systems and Control.

University of North Carolina at Charlotte—*Master of Science in Computer Engineering*

A Master of Science in Computer Engineering (M.S.E.E.) degree requires successfully completing 30 approved graduate credits. Both thesis and non-thesis options are available. Students must decide on their M.S.E.E. option by the end of the second semester when they submit their Plan of Study.

North Carolina State University —*Master of Science in Computer Engineering*

A Master of Science in Computer Engineering degree requires completing 24 graduate credits. The program must be completed in-person and the students can decide on a concentration after their first year of courses.

Potential Southeastern Competitors

Georgia Institute of Technology—*Master of Science in Computer and Computer Engineering*

The master's degree allows students to pursue advanced work in Computer and computer engineering technical interest areas, including bioengineering; computer systems and software; digital signal processing; Computer energy; electromagnetics; electronic design and applications; microsystems; optics and photonics; systems and controls; telecommunications; and VLSI systems and digital design.

Virginia Tech—*Master of Engineering in Computer Engineering*

Virginia Tech ECE faculty and students delve into all major areas of Computer and computer engineering. As one of the country's larger ECE departments, the university offers strong education and research opportunities in diverse areas, including computers, control systems, communications, electronics, electromagnetics, and power.

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University of Virginia—*Master of Engineering and Master of Science in Computer Engineering*
The University of Virginia offers two master's degrees, a Master of Science (MS) that requires a thesis and a Master of Engineering (ME) that does not. Students receiving financial support from the department in the form of a GRA, GTA, or a fellowship will generally be required to pursue the master of science (thesis) option unless approval is obtained from the EE Graduate Committee. Students enrolled in the master of science program must obtain the agreement of an advisor to supervise a master's thesis.

University of Florida—*Master of Engineering and Master of Science in Computer Engineering*
The Department of Computer and Computer Engineering in the Herbert Wertheim College of Engineering offers both the Master of Engineering and Master of Science degrees. Areas of graduate study and research include computer engineering, devices, electromagnetics and energy systems, electronics, and signals and systems. Students in either degree track select from a thesis or non-thesis option.

Auburn University—*Master of Science in Computer and Computer Engineering*
Auburn University's Computer and Computer Engineering (ECE) department offers graduate programs of instruction and research leading to master's and doctoral degrees. Instruction is offered, and research facilities are available to support graduate study in control systems and robotics; digital signal processing and communications; wireless engineering; electromagnetics modeling and analysis; microelectronics and microelectromechanical systems (MEMS); magnetic resonance imaging (MRI); power systems; digital systems; and computer engineering. Additionally, individualized programs that cross the traditional boundaries of engineering, mathematics, and the sciences can be accommodated.

Potential National Competitors

Stanford University—*Master of Science in Computer Engineering*
Stanford's master's degree program in Computer engineering provides advanced preparation for professional practice through a highly customizable, coursework-based curriculum. Students complete 45 units of study based on an individually designed course plan that satisfies the department's depth, breadth, and technical course requirements. There is no thesis requirement. Typical completion time for the master of science degree is one and a half to two years for full-time students. The school also offers an honors Cooperative Program which enables working professionals to pursue the master of science on a part-time basis.

Purdue University--West Lafayette—*Master of Science in Computer and Computer Engineering*
Purdue's ECE master's program is offered as thesis and non-thesis options. Students are aided by their Advisory Committee of faculty members in formulating an individual plan of study that satisfies the degree requirements and matches their own needs, interests, and long-term goals. They select from area-specific courses, including automatic control; biomedical imaging and sensors; communications, networking, signal and image processing; computer engineering (AI, computer architecture, software systems); energy sources and systems; fields and optics; microelectronics and nanotechnology; and VLSI and circuit design.

University of Texas--Austin (Cockrell)—*Master of Science in Computer and Computer Engineering*
UT's Cockrell School of Engineering master of science degree program offers nine different Academic Tracks, areas of interest that students choose to help guide them in selecting a course of study and research area. These include architecture; computer systems and embedded systems; biomedical engineering; decision, information, and communications engineering; electromagnetics and acoustics; energy systems; integrated circuits and systems; plasma/quantum electronics and optics; software engineering and systems; and solid-state electronics.

University of Michigan--Ann Arbor—*Master of Science in Computer and Computer Engineering*
Michigan's master of science degree is administered through its Rackham Graduate School, and students select from one of 12 areas of emphasis. These include applied electromagnetics and RF circuits; computer vision; control systems; embedded systems; integrated circuits and VLSI; MEMS and microsystems; network, communication, and information systems; optics and photonics; power/energy; robotics; signal and image processing and machine learning; and solid state and nanotechnology. The degree requires successful completion of 30 hours of coursework, and a thesis is optional. Students normally complete the program in one to two years.

University of Southern California—*Master of Science in Computer Engineering*
Students pursuing the Master of Science in Computer Engineering must meet the general requirements of the Viterbi School of Engineering and must complete a minimum of 28 hours of coursework, with at least 20 units in Computer engineering courses. A minimum grade point average of 3.0 must be obtained in all coursework applied to the degree.

Columbia University—*Master of Science in Computer Engineering*
The Computer engineering master of science program is flexible and customizable to the student's individual goals. It allows students to pursue Computer engineering disciplines in depth, as well as to take a selection of courses from other Columbia engineering majors. Students can study topics including physical devices; circuits and systems; communications and networking; signal, information, and data processing; computer engineering; smart electric energy; and systems biology or neuro-engineering.

Johns Hopkins University—*Master of Science in Computer and Computer Engineering*
The part-time Computer and Computer Engineering program at Johns Hopkins Engineering for Professionals is one of the largest graduate degree programs in Computer and computer engineering in the country. From a thorough grounding in foundational topics, such as electromagnetics, electronic devices, and systems theory, to building the hardware and software architectures of next-generation mobile platforms, students gain valuable skills for professional advancement.

University of Minnesota-Twin Cities—*Master of Science in Computer Engineering*
The Master of Science in Computer Engineering program is available in four delivery formats: via classroom, completely online, primarily online (at least 80% online with short, intensive periods of face-to-face coursework), and partially online (50 to 80% online). The Department of Computer and Computer Engineering offers diverse educational programs that encompass nearly all aspects of modern Computer and computer engineering, ranging from the very theoretical system and information theory to highly experimental work in novel device research and microelectronics. There are numerous emphases in the major from which to choose, and interdisciplinary work is also available in six other areas.

University of Colorado Boulder— *Master of Engineering in Computer Engineering*

CU Boulder offers two Computer engineering master's programs, a Master of Science (MS), which is a traditional graduate degree, and the Master of Engineering (ME), which is broad-based and designed especially for students who want to further their education in more than just Computer engineering. The options are tailored to both working engineers looking to advance their careers and to those looking to pursue a career in academia. Research is concentrated in six broad areas: optics, nanostructures and bioengineering; communications and signal processing; computer engineering; dynamics and controls; electromagnetics, RF and microwaves; and power electronics. Thirty credit hours of coursework, including thesis hours, are required.

The Pennsylvania State University—*Master of Engineering in Computer Engineering*

Penn State's program can be a terminal degree, or it can focus on preparing for the PhD. The 32-credit degree program can be research oriented or can emphasize graduate-level coursework. If the student chooses the latter emphasis, they also have the choice of the one-year master of science program track or standard program track (typically two years). Students have the option of a thesis or a satisfactory scholarly paper, although the course requirements are slightly different for the two options.

Arizona State University – *Master of Science in Engineering in Computer Engineering*

Arizona State University's MSE in Computer Engineering is offered completely online, and designed to prepare its graduates for careers as Computer engineers, energy engineers, engineering managers, nuclear engineers, and solar energy systems engineers. The 30-credit program contains a total of 10 classes, of which a minimum of 5 must be Computer engineering courses. The areas of study emphasized in the program include physical electronics and photonics, electronic and mixed-signal circuit design, signal processing and communications and electromagnetic, antennas and microwave circuits.