

# *Applied Machine Learning Bootcamps:*

## Career Interests in Machine Learning



**NACME**

NATIONAL ACTION COUNCIL FOR  
MINORITIES IN ENGINEERING

# The National Action Council for Minorities in Engineering (NACME)

The National Action Council for Minorities in Engineering (NACME) was established in 1974 by a group of concerned business leaders to develop and catalyze a suite of strategies to increase the participation of individuals from populations that have been historically underrepresented in engineering, specifically Black/African American individuals, Hispanic or Latino/a individuals, and Native American individuals (sometimes grouped together as “underrepresented minorities” or “URMs”).<sup>1</sup> In recent years, NACME has also expanded to include a focus on broadening participation in computing. Despite some strides, the challenge of diversifying the engineering profession remains—and has not kept up with the nation’s demographic reality.

## The Applied Machine Learning Bootcamp

In our rapidly advancing digital age, computational engineering stands at the forefront of progress. It's an exciting multidisciplinary realm that harnesses next-gen computational techniques, reshaping engineering and influencing industries worldwide. Yet, a persistent gap exists for equitable access to computer science, machine learning, and AI education across diverse groups, including those defined by race, gender, socioeconomic status, and geography.

Enter the Google Applied Machine Learning (AMLI) Bootcamp - a groundbreaking collaboration between the National Action Council for Minorities in Engineering (NACME) and Google Education. This summer initiative tackles this inequity by providing underrepresented minority (URM) undergraduate students with opportunities to bridge this educational divide.

In just two summers since its 2021 launch, the AMLI Bootcamp has increased the interest of 124 students in computing engineering careers at three public research-intensive universities - the University of Kentucky, the University of Arkansas, and Morgan State University. Regardless of the delivery method - online-only, hybrid, or in-person - every student has reaped the benefits of immersive, hands-on learning and robust professional development.

The AMLI Bootcamp was not just about learning; it also included professional preparation and growth. Students attending in-person sessions enjoy comprehensive support, from room and board to travel stipends and elective credits, ensuring a well-rounded and transformative experience.

<sup>1</sup> Underrepresented minority groups include Hispanic/Latinx, Black or African American, and American Indians or Alaska Natives. Diversity and STEM: Women, Minorities, and Persons with Disabilities. National Center for Science and Engineering Statistics (NCSES) 2023.

## Tracing Career Aspirations

To evaluate AMLI's effectiveness, student learning journeys and outcomes were assessed using pre-assessments and post-assessments and uncover their interests in specific careers related to machine learning. Students were given ten careers to consider: Software Engineer, Software Programmer, Software Developer, Data Scientist, Computer Engineer, Artificial Intelligence Research Scientist, Cloud Engineer, Machine Learning Scientist, Machine Learning Engineer, and Big Data Engineer.

### Summer 2021 Career Interests in Machine Learning <sup>2</sup>

The initial AMLI boot camp in 2021 welcomed **62 students** across the three participating universities. Based on 59 respondents, the typical student identified as male (62.7%), African American (55.9%), non-Hispanic (54.2%), and without a disclosed disability (93.2%). Nearly 60% of the students were of junior or senior status, 55.9% reported majoring in Engineering, and approximately 60% expected to earn at least a Master's degree.

**Pre-Assessment >>>** At the beginning of the boot camp, the top four careers students expressed interest in were **software engineering** (M=3.74), **software development** (M=3.63), **software programming** (M=3.58), and **machine learning engineering** (M=3.58).

**Post-Assessment >>>** By the end of the boot camp, students remained interested in **software engineering** (M=3.81), **software development** (M=3.81), and **software programming** (M=3.66). However, they were less interested in machine learning engineering and more interested in **artificial intelligence research** (M=3.58).

### Summer 2022 Career Interests in Machine Learning <sup>2</sup>

The 2022 AMLI boot camp welcomed 62 students across the three participating universities for the second year. The typical student identified as male (74.6%), African American (74.6%), non-Hispanic (73%), and without a disclosed disability (90.5%). Nearly 60% of the students were of junior or senior status, 55.6% reported as engineering majors, and over 40% expected to earn at least a Master's degree.

**Pre-Assessment >>>** Similar to 2021, the top four careers students expressed the most interest in were **software engineering** (M=3.71), **software development** (M=3.64), **software programming** (M=3.64), and **machine learning engineering** (M=3.62).

**Post-Assessment >>>** At the end of boot camp, the top three careers remained the same **software engineering** (M=3.84), **software development** (M=3.79), and **software programming** (M=3.30). It is worth noting, that students at the University of Kentucky expressed great interest in **machine learning engineering** (M=4.21).

Our commitment is unwavering—to guide students in understanding the diverse career paths in machine learning. From 2021 to 2022, the data reveals an encouraging consistency of budding professionals who remain enthusiastic about software development, engineering, and programming. The promising interest in AI—exemplified by phenomena like ChatGPT—highlights the imperative for a broader, more diverse talent pool in computational disciplines.

<sup>2</sup> Data extracted from AMLI Reports by NACME; 2022. Results are the mean value (M=) across all participating universities using a 5-point Likert scale from 1 (not at all interested) to 5 (very interested).

## The Way Forward

While the AMLI Bootcamp successfully maintained student interest in machine learning careers, enthusiastic interest is only part of the endgame. The endgame is on tangible outcomes—degrees and dynamic careers for these promising scholars.

Recent statistics<sup>3</sup> such as these from the National Center for Science and Engineering Statistics (NCSES) highlight the pressing need for programs like the AMLI Bootcamp:

- The representation of Black students is lowest in engineering, where Black students earned 5% of bachelor's degrees. From 2011 to 2020, this share remained nearly unchanged, even though the number of engineering degrees earned by Black students steadily increased.
- Across all fields of Science and Engineering (S&E), Black individuals are underrepresented at the bachelor's degree level relative to their share of the 18- to 34-year-old population (14% in 2021).
- Similarly, American Indian or Alaska Native students account for a low and declining share of S&E degree recipients. At a mere 0.3%, the percentage of degrees earned by American Indian or Alaska Native students is lowest in mathematics, computer sciences, and engineering.
- The number of Science and Engineering bachelor's degrees awarded to American Indian or Alaska Native students dropped by 22% from 2011 to 2020.
- In contrast, the share of bachelor's degrees earned by Hispanic students has increased in mathematics and computer science (from 8.8% in 2011 to 12.8% in 2021) and engineering (from 9.2% in 2011 to 14% in 2021) over the past decade. This growth has occurred in tandem with a significant increase in the Hispanic share of the population of typical degree-seeking age - from 20% in 2011 to 22% in 2023.

While there's a glimmer of hope with the increase of Hispanic representation in engineering and computer science, African American, American Indian, and Alaska-Native students continue to face persistent underrepresentation in science and engineering, specifically within computer science and computer engineering disciplines. Current labor statistics<sup>4</sup> as shown in the table below emphasize the underrepresentation.

Job Title <sup>4</sup> (Occupation)	Women	Black or African American	Hispanic or Latino
Computer & Mathematical	26.20%	8.50%	8.30%
Computer Programmers	19.50%	6%	6.40%
Software Developers	19.70%	5.40%	5.80%

<sup>3</sup> Data sourced from Diversity and STEM: Women, Minorities, and Persons with Disabilities. National Center for Science and Engineering Statistics (NCSES) 2023.

<sup>4</sup> Labor Force Statistics from Current Population Survey. U.S. Bureau of Labor Statistics, September 2022.

## Key Takeaways >>>

- ★ **Impactful Reach and Diverse Learning Methods >>>** Over two years, the Bootcamp reached **124 underrepresented students across three universities**, offering them vital knowledge and skills through online-only, hybrid, and in-person platforms. This approach ensures accessibility and flexibility for all participants.
- ★ **Consistent Interest in Core Machine Learning Careers >>>** Assessment data from 2021 and 2022 reveal increased career interest in software development and engineering but less interest in software programming. Additionally, interest trends point towards increasing enthusiasm for artificial intelligence research and machine learning engineering.
- ★ **The Reality of Representation in Science and Engineering >>>** Current statistics from the NCSES highlight the persistent underrepresentation of Black and American Indian or Alaska Native students in science and engineering degrees. While the representation of Hispanic students is increasing, the overall representation of certain minority groups remains disproportionate to their population percentage.
- ★ **Significance of AMLI's Role >>>** The NCSES data solidifies the crucial role of initiatives like the AMLI Bootcamp. It stands as an influential program that nurtures underrepresented career interests in software engineering and development. It also has the potential to progressively reshape the landscape of diversity and inclusivity in computational fields.

## Let's Bridge the Equity Gap

As evidence-based research advocates, NACME invites you to lend your expertise and passion to create a world where every aspiring mind, regardless of background, can flourish and contribute to the transformative landscape of engineering and technology.

By joining our collaborative efforts, you will play a pivotal role in designing and implementing programs that address the disparities in access, ensuring that every aspiring student, regardless of their background, has an equal opportunity to thrive in these rapidly evolving fields.

As you embark on this journey with us, your dedication will inspire countless young minds, ignite a passion for learning, innovation, and growth, and become a driving force in bridging the gap of inequity in computer science, engineering, and AI education for underrepresented minority undergraduate students.

Let's forge a path toward a more equitable and promising future in technology and beyond.



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