

Bachelor of Applied Science in Robotics and Artificial Intelligence

July, 2018



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Cover Sheet

STATEMENT OF NEED

Program Information

Institution Name: Bellevue College

Degree Name: Bachelor of Applied Science in Robotics and Artificial Intelligence CIP Code: 11.0102 and/or 14.4201

Name(s) of existing technical associate degree(s) that will serve as the foundation for this program:

Degree: Information Systems AAS-T Degree CIP Code: 11.0201 Year Began: 2012

Degree: Robotics and Artificial Intelligence AAS-T Degree CIP Code: 15.0405 Year Began: 2018

Proposed Start Implementation Date (Fall 2014): Fall 2019

Projected Enrollment (FTE) in Year One: 8 25 at Full Enrollment by Year: Fall 2023

Funding Source: State FTE: Self-Support: Other:

Mode of Delivery

Single Campus Delivery: Bellevue College Main Campus

Off-site: N/A

Distance Learning: Hybrid/Blended; some fully online

Statement of Need: *Please see criteria and standard sheet FORM B.*

Page Limit: *20 pages*

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Date

“Today, we are at the beginning of a Fourth Industrial Revolution. Developments in genetics, artificial intelligence, robotics, nanotechnology, 3D printing and biotechnology, to name just a few, are all building on and amplifying one another. This will lay the foundation for a revolution more comprehensive and all-encompassing than anything we have ever seen.”

World Economic Forum:
Global Challenge Insight Report,
January 2016

Introduction to the Degree

These words foretell the onset of a new and unremitting period of technological change. This change, many experts agree, is being realized as the long awaited promise of robotics and artificial intelligence research has begun to take hold throughout the economy.¹ Robotics and artificial intelligence, it seems, are no longer the realm of science fiction alone.

Evidence that robotics and artificial intelligence (AI) are now more reality than fantasy can be seen in the substantial increases in spending in these fields, where investment has far exceeded expectations. The World Economic Forum, for example, predicted in 2016 that worldwide spending on robotics would increase from 15 billion to about 67 billion between 2010 and 2025.² As bold as this prediction seemed, International Data Corporation’s (IDC) recently updated Worldwide Semiannual Robotics and Drone Spending guide indicates that actual spending on robotics had already reached 84.4 billion in 2017 and is expected to total 103.1 billion in 2018. By 2021, IDC experts anticipate that robotic spending will more than double to 218.4 billion.³

Investment in AI is much the same story. According to the New Vantage Partner’s annual executive survey, published in January of 2018, 97.2% of executives from Fortune 1000 companies are investing in building or launching AI initiatives. Among those executives surveyed, 76.5% also indicated that the proliferation and greater availability of data is responsible for the increased investment in AI initiatives, confirming a growing consensus that big data and AI are becoming more closely intertwined. Industry-leading companies recognize more than ever that advances in big data, AI, machine learning and natural user interfaces are making it possible to automate knowledge-worker tasks that just a short time ago had been thought impractical, if not

¹ <http://reports.weforum.org/future-of-jobs-2016/preface/> See also: Pew Research Center, Key Insights: Expert Views on Artificial Intelligence, Robotics, and the Future of Jobs, <http://www.pewinternet.org/2014/08/06/key-insights-expert-views-on-artificial-intelligence-robotics-and-the-future-of-jobs/>, NewVantage Partners’ annual executive survey, (January 2018), <http://newvantage.com/wp-content/uploads/2018/01/Big-Data-Executive-Survey-2018-Findings-1.pdf>;

² Sander, A & Wolfgang, M, The Rise of Robotics, Boston Consulting Group Perspectives, <https://www.bcg.com/publications/2014/business-unit-strategy-innovation-rise-of-robotics.aspx>

³ International Data Corporation, Worldwide Semiannual Robotics and Drones Spending Guide (2018), <https://www.idc.com/getdoc.jsp?containerId=prUS43519218>

impossible. Such advances brought total investment in AI to 643.7 million in 2016. By 2025, this total investment is expected to reach 38.8 billion.⁴

Given such financial optimism, there can be little doubt that we have arrived at a watershed moment in technological history. A megatrend is clearly underway that will give rise to a new and emerging period of innovation.

The question for educational institutions is how they will respond to these developments. Because economic change of this scale is often accompanied by talent shortages, unemployment and inequalities, educational institutions must provide the cutting-edge preparation, training, and upskilling for today's students and workers so that they may adequately adapt to this rapidly changing environment.

To meet the challenges of this impending period of transition, Bellevue College proposes the development of a Bachelor of Applied Science degree in Robotics and Artificial Intelligence. This degree will prepare graduates to work in the field of robotics and AI application development. The program will provide students with the knowledge and skills to design, implement, and analyze basic machine-learning and embedded systems that run robotics and AI applications. In addition, the program will introduce students to the science of computer vision, the fundamentals of robotics control systems and the use of 3D printing to develop and test prototypes. Such training will position graduates to undertake entry level roles in robotics, AI and machine learning. Upon completion of the program, graduates will be prepared to work in a wide array of positions, including robotic technicians, application developers and software developers with specializations in robotics, AI and machine learning applications.

Program outcomes include learning to:

- Communicate effectively in the three areas of listening, writing and speaking
- Apply critical thinking and logical research to solve technological problems
- Apply basic statistical methods, time series analysis and forecasting to solve robotics and AI programming problems
- Apply the basics of Python programming language to solve analytical and statistical problems related to machine learning
- Model, design, and analyze embedded system hardware and software architectures and communication protocols
- Design, develop and test control systems for robotics applications based on machine vision
- Apply 3D printing techniques to build models and prototypes

Degree Origins

The genesis of this degree program arose from research conducted by the State Board of Community and Technical College's Center of Excellence for Information and Computing Technology (CoE for ICT) and Bellevue College (BC). Together, these institutions produced a 2016 white paper that concluded:

⁴ (Tractica, 3Q2016,) <https://www.tractica.com/newsroom/press-releases/artificial-intelligence-revenue-to-reach-36-8-billion-worldwide-by-2025/>

- Robotics, AI, Machine Learning and Predictive Analytics, fields undergoing momentous and complimentary change, will transform all sectors of the economy.
- Job demand for robotic technicians, AI/machine learning embedded programmers, and predictive analytic professionals is bright and will continue to rise over the next decade.
- A significant skills gap exists in the fields of robotics, AI and machine learning, a gap which community colleges are poised to help close with degree development at both the AA and BAS levels.⁵

This initial research led the CoE for ICT and BC to develop an introductory trial course in robotics and AI, convene two separate industry focus groups that examined curriculum possibilities for associate and applied bachelor degrees and conduct surveys of industry and student demand for degree programs in robotics and AI.

The results of these additional exploratory efforts were telling. First, students ranked modules within the trial robotics and AI course as 8+ out of 10 on a satisfaction scale, indicating general approval of the course material and interest in fields as a whole. Second, participants in both focus groups indicated that an AA degree and BAS degree were desirable and would lead to job placement at the entry level. Finally, industry and student demand surveys showed strong interest in the development of robotic and AI degree programs where appropriate training for workers could be found and forward-looking opportunities for students could be sought.⁶

Relationship to institutional role, mission and program priorities

BC requires that every new program align to its mission, which states:

Bellevue College is a student-centered, comprehensive and innovative college, committed to teaching excellence that advances the life-long educational development of its students while strengthening the economic, social and cultural life of its diverse community. The college promotes student success by providing high-quality, flexible, accessible educational programs and services; advancing pluralism, inclusion and global awareness; and acting as a catalyst and collaborator for a vibrant region. (Approved by Board of Trustees, June 11, 2008.)

Developing baccalaureate degrees is a fully integrated component of BC's strategic planning. "Applied Baccalaureate Development" is a president's cabinet-level priority, with goals assessed annually. Baccalaureate degrees are developed through careful consideration of the college's strengths and strategic enrollment goals. Also considered are workforce needs, community demand, and the sustainability of each proposed degree. In addition to continuing education, certificates, professional/technical and transfer degrees, baccalaureate degrees are a means through which BC provides the level of education required by local employers and citizens. As

⁵ Majury, Maureen & Royer, Michèle, Robotics and Automation: A Retrospective and the Reality of Bot Nation, (June, 2016) <https://www.coeforict.org/2016/07/robotics-and-automation-a-retrospective-and-the-reality-of-bot-nation/>

⁶ See appendixes C & G

the entry level criterion shifts from a two-year to a four-year degree in multiple fields, BC assesses the need for applied bachelor's degrees to meet demand for highly skilled employees, and to ensure that our area residents will have access to the education needed for success in their chosen fields.

BC's commitment to both employers and residents as well as to its strategic enrollment goals is evident in BC's recently updated strategic plan. Revised in 2017, this strategic plan organizes priority initiatives for the next five years around the college's established four core themes. Central to strategic plan core theme two - Teaching and Learning Excellence – is priority initiative A, which explicitly states that BC is to “[d]evelop and support new initiatives, certificates, credentialing models, and degrees—such as expanded baccalaureate programs—that meet the needs of the region.” This commitment is also evidenced in BC's evolving strategic enrollment management plan, conceived in 2017 and implemented beginning in 2018. A key component of this enrollment management plan is to decrease the attrition rate of student within the 20-29 age bracket. This age group represents 40% of BC's enrollments. Since baccalaureate students at BC tend to fall between twenty-five to twenty-nine years old, new baccalaureate programs are an expressed strategy in the effort to reduce attrition within this critical age bracket.

BC is committed to developing four-year degrees that build on the college's existing areas of expertise and fulfill unmet local need. The BAS in Robotics and Artificial Intelligence is a fitting addition to the college's excellent two-year and four-year programs in computer science, information technology and data analytics. The addition of this robotics and AI degree will address current and growing unmet need for employees in this emerging, dynamic field. In 2009, BC was granted accreditation by the Northwest Commission of Colleges and Universities (NWCCU) to offer baccalaureate degrees. The college currently offers twelve bachelor's degrees. These degrees are:

- BAS in Data Analytics
- BAS in Digital Marketing
- BAS in Applied Accounting
- BAS in Information Systems and Technology
- BAS in Healthcare Informatics
- BAS in Radiation and Imaging
- BAS in Healthcare Promotion & Management
- BS in Nursing
- BAS in Healthcare Management & Leadership
- BAS in Molecular Biosciences
- BAA in Interior Design
- BS in Computer Science

Baccalaureate degrees play an important role in BC's commitment to provide high quality, flexible, accessible education programs and strengthen the economic life of its diverse community.

Support of statewide strategic plans

In proposing this BAS in Robotics and Artificial Intelligence, BC reaffirms its supports for the goals outlined in the State Board for Community and Technical College's (SBCTC) Mission Study and the Washington Student Achievement Council's Education Roadmap. Both plans identify strategies to increase the number of baccalaureate-educated adults as a means to strengthen the economy and serve workforce needs for more highly educated "locally grown" workers that will:

- Strengthen state and local economies by meeting the demands for a well-educated and skilled workforce;
- Achieve increased educational attainment for all residents across the state;
- Use technology, collaboration and innovation to meet the demands of the economy and improve student success.
- Ensure Access
- Enhance Learning
- Prepare for Future Challenges

Employer and community demand

Bellevue's Unique Position

BC is located within the Bellevue city limits on the central-east side of Lake Washington. The land around Puget Sound is the most highly and densely populated area of Washington State, home to more than 50% of the state's population. Five cities of over 100,000 exist within a 30 mile radius of main campus: Bellevue (144,444), Everett (110,079), Kent (128,458), Seattle (724,745) and Tacoma (213,418).⁷

BC's location, surrounded by small and large high-tech companies, is positioned well for a new applied bachelor's degree in robotics and AI. Not only will this new degree provide companies the opportunity to employ newly trained robotic and AI professionals, but also it will expand options and pathways for community college students.

Labor market data

Many experts believe advances in robotics and AI will pervade nearly every aspect of daily life by 2025, with huge implications for healthcare, transport and logistics, customer service, and home maintenance.⁸ Although these experts disagree about how advances in robotics and AI will

⁷<https://www.census.gov/quickfacts/fact/table/tacomacitywashington,seattlecitywashington,kentcitywashington,everettcitywashington,bellevuecitywashington,US/PST045217> (2017 estimates)

⁸ Pew Research Center, Internet & Technology, AI, Robotics and the Future of Jobs, Smith, Arron and Anderson, Janna (August 6, 2014) <http://www.pewinternet.org/2014/08/06/future-of-jobs/>

impact employment—their views divided evenly between belief in vast job displacement and vast job creation—most contend that our educational system, at present, is not adequately preparing job seekers for this robotics and AI future. Even job seekers who are well-trained in the required skills for today’s high tech job market, these experts argue, will find it increasingly difficult to stay employed without rigorous, dedicated study of robotics and AI. As a precondition of employment then, hiring agents will undoubtedly recruit and hire candidates who understand the fundamentals of robotics, artificial intelligence, machine learning and predictive analytics. To do anything less would render employers unable to adapt and survive the economic and social disruptions that robotics and AI will inevitably cause.

To capture current and projected demand for its proposed BAS in Robotic and Artificial Intelligence program, BC mined several datasets that comprised:

- An environmental scan of workplace robotic and AI trends (See Introduction)
- Regional employment data provided by Economic Modeling Specialists International (EMSI) reports
- Current job postings data through Indeed.com, O*Net, and the Washington State Employment Security Department
- An employer survey
- Two employer focus groups

[Economic Modeling Specialists International \(EMSI\) report](#)

Because robotics and AI are new and emerging fields, workforce data that shows substantial growth for jobs in these fields is a challenge to collect. Robotics and AI careers do not yet have Standard Occupation Codes (SOCs) assigned by the Bureau of Labor Statistics as they are updated only every ten years. This said, some data is available, and becoming more available everyday as confidence and investment grow in these burgeoning sectors of the economy. Job postings screened for the attributes of robotics and AI, for example, offer analytics on the number of unique job posting occurrences. Still, to demonstrate workforce demand for this proposed program, one must review demand for workers in the computer and information systems sector as a whole as well as for software developers and systems analysts in robotics and AI specifically.

EMSI is a labor market data firm that provides comprehensive labor market data derived from the Bureaus of Economic Analysis, the Bureau of Labor Statistics, the U.S. Census Bureau, the Employment and Training Administration and the U.S. Railroad Retirement Board. BC’s EMSI data research reports describe a robust labor market in King County for computer and information managers, computer systems analysts, application software developers, systems software developers and other computer occupations. From February 2017 to February 2018, 161,750

unique job postings seeking applicants with bachelor level education occurred in these

Occupation Summary for 5 Computer and Information Systems Sector Occupations				
Number of Jobs (2018)	Projected Jobs (2028)	Growth in Jobs	% change (2018-2028)	Median Hourly Earnings (2018)
83,314	98,077	14,763	17.7%	\$59.32/h

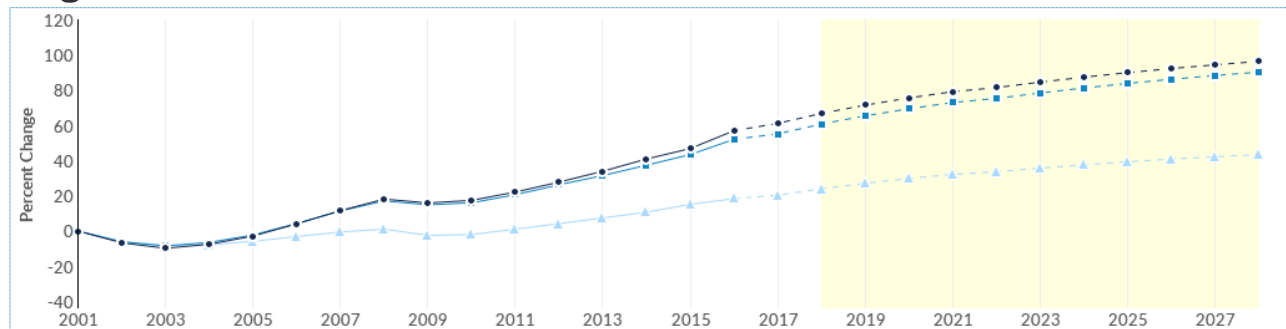
fundamental occupations, with a majority listed in Seattle, Redmond, Bellevue and Kirkland. The chief companies placing these job postings were Amazon, Microsoft, Oracle and T-Mobile, all located within King County, the county in which BC’s resides. The current total number of jobs in these occupations is 83,314. Projected growth for these occupations is 17.7% in the next decade, which will bring total jobs to 98,077. Medium hourly wages for these occupations is currently \$59.32 per hour, more than 10 dollars above the national average. By all measures then, job demand and wages for computer and information systems jobs are strong, particularly in King County, and will continue to be strong throughout the next decade.

Table I below breaks down the five fundamental occupations, showing occupation title, standard occupation code, number of jobs in 2018, projected number of jobs by 2028, percentage growth from 2018 to 2028 and Median Hourly Earnings. Graph I (also below) compares this job data by region (King County), State and Nation. Together, the table and graph vividly capture the robust economic outlook for these occupations.

Occupation Title	Occupation Code	2018 Jobs	2028 Jobs	Change	% Change	Median Hourly Earnings
Software Developers, Applications	15-1132	44,711	52,479	7,768	17%	\$62.38
Software Developers, Systems Software	15-1133	10,787	12,448	1,661	15%	\$57.03
Computer Systems Analysts	15-1121	12,751	15,676	2,925	23%	\$47.09
Computer & Information Systems Managers	11-3021	9,446	11,240	1,794	19%	\$71.59
Computer occupations, All Others	15-1199	5,619	6,233	614	11%	\$41.30

Table I

Regional Trends



Region	2018 Jobs	2028 Jobs	Change	% Change
Region	83,314	98,077	14,763	17.7%
State	109,180	129,240	20,060	18.4%
Nation	2,531,708	2,928,837	397,129	15.7%

Graph I

When the EMSI job posting data is screened for specific references to robotics and AI, the results show a healthy and emergent economic sector where job demand is mounting. For the same fundamental occupations above, 6,594 unique job postings seeking applicants with bachelor-level education and experience in robotics, AI or both occurred. Amazon led all companies for these job postings, but Microsoft, Google, Tableau and Oracle also showed strong interest in candidates with these attributes. The top position recruited for these robotic and AI attributes was Application Software Developer. Even more telling for BC students were the number of robotic and AI jobs listed for specific cities located close to the campus: in Seattle alone, there were 4,712 unique job postings for robotic and AI positions. Redmond listed 1,001 positions for these fields, and Bellevue specified another 672 positions with these skills.⁹

[Indeed.com](#)

Although the EMSI data shows strong demand for robotic and AI jobs within BC’s service area, it also, admittedly, represents a more conventional view of job types within this occupational sector. Standard Occupation Codes document current and historical job titles well, but do not capture ground-shifting trends or new and emerging job titles and careers. The EMSI data, then, offers only a portion of the robotic and AI demand story.

To convey a more complete story and offer a greater sense of demand for robotic and AI careers in particular, BC researched Indeed.com, the most-used job search engine in the country. Employing the search terms “robotics” and “artificial intelligence,” BC discovered informative results.

A snapshot search provided 1,930 bona fide job postings for robotic and AI professionals within a 25 mile radius of the city of Bellevue. Among the jobs posted were AI Developer, Software Engineer– Artificial Intelligence, Software Engineer--(New Graduate 2018), Software Development Engineer– Robotics, Artificial Intelligence/machine learning Security Architect, Software Engineer (Computer Vision, Robotics) and Software Engineer (3D graphics, MR/VR/AR).¹⁰ These postings indicate that robotic and AI positions are not only prominent, but are rapidly becoming some of the most sought after positions within the high-tech industry.

[O*NET and Washington Employment Security Department \(ESD\)](#)

Research at the Occupational Information Network (O*NET) and at Washington’s Employment Security Department (ESD) confirms and supports the high demand, dynamic profile captured by

⁹ See Appendix A for a sampling of these EMSI job postings.

¹⁰ See Appendix B for a sampling of these Indeed.com job postings.

the EMSI and Indeed.com data. O*NET is a free online database that contains hundreds of occupational definitions to help students, job seekers, businesses and workforce development professionals understand today's world of work in the United States. While O*Net is not a strong source of regional or county job demand data, it is nevertheless the nation's primary source of occupational descriptive information, providing valid data that are essential to understanding the rapidly changing nature of work and U.S. workforce. From this information, software applications are developed to facilitate the development and maintenance of a skilled workforce. Central to O*NET is its database, which contains hundreds of standardized and occupation-specific descriptors on almost 1,000 occupations covering the entire U.S. economy.

The Washington ESD is the chief government agency managing unemployment, job training and searches and employer taxes. O*Net is a premier source for discovering and defining new and emerging careers. The Washington ESD is the most important government agency providing employer demand reports for various counties within the state.

A search of the O*Net database using the key words “robotics” and “artificial intelligence” generated a wide sampling of career opportunities for baccalaureate trained professionals.

Among the many opportunities, three stood out:

Application Software Developers were categorized as “Bright Outlook” occupations. O*Net defines “Bright Outlook” occupations as those that match at least one of the following criteria:

- Projected to grow much faster than average (10% or more) over the period 2016-2026
- Projected to have 100,000 or more job opening over the period 2016-2026
- New and Emerging occupation in a high growth industry

The other two, robotics technician and robotics engineer, were labeled as “Green Enhanced Skills” occupations. O*Net defined green jobs as those that “will likely change as a result of the green economy,” causing significant change to the work and worker requirements as well as increasing the demand for these occupations. ¹¹

A review of Washington ESD county demand reports also showed a highly positive demand outlook for the fundamental occupations requiring skills in robotics and AI skills. Drawing from real-time labor demand data provided by Help Wanted Online and Wanted Analytics, the ESD produces reports documenting the top 25 occupations advertised online. For King County, the county in which BC resides, Application Software Developers, Computer Occupations, all others and Computer and Information Systems Managers made the top 25 list in the month of May 2018, the latest month reported. Application Software Developers ranked number 1 on the list; Computer Occupations, all others ranked number 2 and Computer and Information Systems

¹¹ O*NET: <https://www.onetcenter.org/>

Managers ranked number 20. In addition, the May 2018 report showed job postings for these occupations totaling 4,640, 2,809 and 2,765 respectively.¹²

In summary, given the demand data provided by EMSI, Indeed.com, O*NET and the Washington ESD, the fields of robotics and AI are clearly high-demand career tracks with strong growth potential and favorable, sustainable, long-term outlooks.

Employer Survey

During the winter of 2018, BC conducted an online employer survey through professional organizations and industry contacts to gauge employer demand and interest for professionals trained in the field of robotics and AI. Survey respondents represented a wide assortment of industries, including aerospace, high-tech and non-profit organizations. They also worked in a variety of senior, executive and management positions. A large number of the survey respondents worked for companies for which their primary service area is Western Washington. A smaller number indicated their markets extended nationwide. A few reported that their service regions spanned international markets. More than half the respondents worked for companies with 500 or more employers. The survey received between 25 and 49 unique employer responses, depending on the survey question. The survey documented a local and regional need for more bachelor level professionals with specific skills in robotics and AI. Itemized below are key results from the survey, which show this need convincingly:

- 77.55% of respondents said that they either strongly agree or agree that the number of software development professionals working in the fields of robotics and AI is growing.
- 63.64% of respondents noted that when hiring robotics and AI software professionals, they expect to hire significantly more bachelor degree than associate degree graduates, or bachelor degree graduates exclusively.
- When asked to describe why they preferred bachelor degree graduates for these hires, they wrote comments such as:
 - “Higher education standards.”
 - “College graduates are more flexible, able to grow with organizations long-term into management, etc.”
 - “More well-rounded education.” (2)
 - “Students with bachelor’s degrees tend to have more critical thinking skills and professionalism.”

¹² Washington State Employment Security Department, Employer Demand Reports, Top 25 Occupations (May 2016) <https://fortress.wa.gov/esd/employmentdata/reports-publications/occupational-reports/employer-demand-report>

- When asked to review and offer comments on the proposed BAS curriculum in Robotics and Artificial Intelligence, they wrote overwhelming in favor of the program direction:
 - “Pretty solid”
 - “I recommend the research paper class requirement be a bit later in the program”
 - “Glad to see courses that deal with contemporary moral problems”
 - “More programming” (this person believed that the 8 courses in programming were not enough”
 - “I think this is a great set of courses and provides what’s needed”
 - “Looks good” (courses) (2)
 - “Maybe more statistics”
 - “Make sure ethics is covered”
 - “Include internship”
 - “Kudos for a solid, focused approach”

Employer Focus Groups

To supplement its labor market research and survey of employers, BC conducted two focus groups to chronicle current employer perspectives on the fields of robotics and AI and measure the value of associate and baccalaureate level education for professionals in the field. The first group, attentive to associate degree level education, met in December 2, 2016. The second, focused on baccalaureate degree level education, convened in March 23, 2018. The consensus of both groups, as stated earlier, was that:

- Training in robotics and AI was increasingly important to the high-tech work environment, if not to all work environments.
- A significant skills gap existed in the fields of robotics, AI and machine learning.
- AA and BAS degrees were desirable, would lead to job placement at the entry level, and would be an important component of closing the skill gap.¹³

The first focus group was assembled to examine the concept of an associate degree program in robotics and AI and devise curriculum appropriate for such a degree. Central to this examination was creation of a curriculum that would provide graduates gainful employment in this emerging field of work.

Participants in this first group overwhelming favored the concept of an AA degree in Robotics and Artificial Intelligence. Below are representative comments from some of the participants.

¹³ See Appendix D for list of participants in Focus Group 1

- “I think it is very exciting that BC is starting this program for its students!”
(Mark Greaves, Technical Director, Analytics, Pacific Northwest National Laboratory, Seattle, WA)
- “I believe that this program will be very helpful in preparing new graduates for the world of AI, robotics and data science. In the same way that CS evolved from an interesting small facet of the economy to a necessary driving force over just a few decades, the AI revolution is about to transform the face of technology. In ten years, the fundamental "unit" of human-computer interface won't be just working with code management tools, but also with AI, ML training and data manipulation tools. To prepare the next generation for this new world, programs like this are absolutely necessary. The skills, tools and knowledge represented by this program are broad, in keeping with the complexity of the new state of the art in AI and robotics...the 2-year program will produce graduates capable of operating at a technician level as well as being conversant with all the terminology and concepts they are likely to encounter...the graduates of these programs will enter a job market very much in need of their technical skills and creative energy.”
(Dr. Sean Robinson, Principal Data Scientist, Pioneer Square Labs)
- “I just read an internal article that says, “Right now, knowledge about machine learning, deep learning, and AI is still very rare. Since many of the most important breakthroughs have occurred after 2014, this stuff is all still extremely new.” They went on to say that they need more people involved for this to evolve. They actually set up some “in house” training to get engineers more involved and over 7000 people signed up for notification when they were going to offer training. My point here is that there is a real need for training and anyone who has some skills will find themselves extremely marketable. I believe that a student with a 2-year degree in AI could have the foot up on Engineers who have work experience.”
(Valerie Goulds, Senior Support Escalation Engineer, Microsoft)

Based on the encouragement of the focus group participants and its own research, BC succeeded in developing an AAS-T degree in Robotics and Artificial Intelligence which will begin in the fall of 2018.¹⁴ The program was approved by the SBCTC on November 13th, 2017 as a program option, residing under its AAS-T degree program in Information Systems.¹⁵ The Northwest Commission for Colleges and Universities (NWCCU) gave its approval to add this degree to BC’s inventory of programs on March 28, 2018.¹⁶

While the efforts of this first focus group may seem immaterial to this present statement of need, we note its contributions because it speaks to two important themes, which we believe fortify the arguments for developing a BAS program.

First, as new and emerging fields, robotics and AI experience large skills gaps that high-tech professionals openly acknowledge. These professionals argue, as evidenced from the commentary above, that innovative, risk-taking colleges should “get into the game” by

¹⁴ See Appendix E – BC’s AAS-T in Robotics and Artificial Intelligence Program Curriculum Sheet

¹⁵ See Appendix F – Electronic Email of Approval from the SBCTC

¹⁶ See Appendix G – Copy of NWCCU Approval Letter of AAS-T Degree in Robotics and Artificial Intelligence

developing degree programs at all levels. This, of course, includes both associate and bachelor degrees. To do otherwise is to postpone the inevitable and place students at a disadvantage in the impending world of work.

Secondly, by realizing its AAS-T program, BC has strengthened the foundation on which it intends to build its baccalaureate program. BC's AAS-T in Information Systems will serve as the primary building block for this robotics and AI BAS program, but the development of the robotics and AI AAS-T program has been a critical first step in helping BC gain confidence and know-how. Our research shows that there are no other fully dedicated robotics and AI programs in the state of Washington at the associate or baccalaureate levels. There is no template from which to build a program, so while developing a BAS degree program in Robotics and Artificial Intelligence presents some risk, BC has not proceeded willy-nilly. Rather, it has acted judiciously by first developing an associate degree program that was thoroughly examined and approved by high-tech professionals, the SBCTC and the NWCCU.

The second focus group, made up of a wide array of IT professionals, was recruited by Northwest Insights, a market research services firm specializing in hosting qualitative research. BC contracted Northwest Insights to broaden its reach of IT experts beyond those of the CoE for IST and its own degree advisory boards. BC's intention was to gain as much objectivity about its proposed robotics and AI BAS program as possible. BC realizes that new program development, especially within new and emerging fields, is a risky venture and likely to require substantial time and investment to create a sustainable academic program. BC paid \$6,890 for Northwest Insight's services, an indication not only of its commitment to objectivity, but also to getting the curriculum offerings right; that is, as right as possible within fields that change daily and are, by many accounts, about to take flight.¹⁷

This second focus group dedicated its energies less to endorsing the viability of a BAS program in Robotics and Artificial Intelligence and more towards vetting a proposed curriculum for such a program. Not that the issue of viability was deemed unimportant, but early in the process, participants agreed outright that robotics and AI would be the leading, dominant drivers of economic life in the near and extended future. Participants unanimously agreed that developing a bachelor-level degree in robotics and AI was timely and vital to providing students with employable skills.

Focus group participants were asked to examine a full slate of proposed robotics and AI courses. These courses included 200, 300 and 400 level courses, covering fundamental and advanced topics in these fields. Examples of courses considered were:

- Programming for Machine Learning (with Python)
- Additive Design and Manufacturing
- Computer Vision in Control Systems

¹⁷ See Appendix D for list of participants in Focus Group 2

- Advanced Computer Visions/Sensors
- Language and Speech Technology
- Advanced AI and Applications for Machine Learning
- Autonomous Systems
- Capstone I & II courses.

In addition, participants reviewed a series of information systems courses deemed essential to information technology work of this manner. These courses encompassed:

- Object Oriented Programming
- Engineering Graphics
- Database Theory
- Business Intelligence Applications
- Predictive Analytics

Finally, participants deliberated a range of general education courses, with an aim of recommending the “soft” skills courses needed to function as a contributing team member in a dynamic, innovative work environment. Courses assessed in this vein comprised:

- English Composition and Technical & Research Paper Writing
- Calculus and Statistics
- Cultural Studies in Mass Media
- Communication in a Diverse Workplace
- Contemporary Moral Problems and Ethical Issues in Information Technology
- Biology
- General, Cognitive and Positive Psychology
- Drama (Scene Technology and Technical Practice)

While the focus group session provided a wealth of feedback on proposed BAS curriculum – participants were in general quite enthusiastic about program in robotics and AI – the key findings entailed the following critical principles and ideas:

1. Primary to work of this kind, robotics and AI specialists should develop broad skills and knowledge in systems thinking; design, building and repairing; complex problem solving; and communications.
2. Since robotics and AI applications interact with hardware and electronics, students should be exposed to a portfolio of programming languages, including Python, C-Sharp, and Java. Even a familiarity with the Raspberry Pi computer tool was suggested. Focus group members also recommended strongly that the Python programming language be introduced in the first year of the program since it is standard-fare for robotic and AI applications.
3. The study of calculus was less important than gaining a strong background in statistics.

4. Exposure to tools and the acts of design, making, and fixing were essential skills, especially for work in robotics. The curriculum should include a basic shop class that teaches welding and soldering.
5. Although ethics should be embedded within all courses, a course undertaking ethical issues in information technology warranted a distinct place in the curriculum.

Appendix F displays a working draft of the proposed curriculum for the BAS degree in Robotics and Artificial Intelligence. This proposed curriculum carefully reflects the advice of the focus group experts. The curriculum includes a range of programming courses, three statistics courses, a “maker” course with welding and soldering, and a dedicated IT ethics course.¹⁸

Focus Group Conclusions

BC believes that its work with both focus groups confirms the employer demand data presented. Robotics and AI is a bright outlook economic sector ripe for explosive growth and influence within all phases of technological, social and economic activity. Developing a dedicated applied bachelor’s degree program to capitalize on this prevailing movement is a rational, well-founded initiative.

Program Completion – Employer Demand Gap:

In contrast to the employer demand data described above, supply of graduates in the fields of robotics and AI is inadequate to meet this demand. Table II below shows degree completions in robotics technology/technician, mechatronics, robotics and automation and AI related programs for 2014, 2015 and 2016. It also shows annual job openings for these same years. This data was compiled by Economic Modeling Specialist International (EMSI), which extracted the degree completions from the Integrated Post-Secondary Education Data System published by the Department of Education’s National Center for Education. The table shows only three years of data because no school in King County had degree completions in these specialized fields prior to 2015, a clear indication of the novelty of these fields.

According to the EMSI data, the University of Washington (UW) is the only school to offer programs related to robotics and AI. The total number of degrees produced over this three year period were 127. Of these completions, 81 were Bachelor degrees and 46 were Master’s degrees. The 81 bachelor degrees were earned in Mechanical Engineering with an option in mechatronics. The 46 master’s degrees were granted from Computer Science Engineering program with concentrations in AI. The EMSI data also estimated the total number of job openings for positions in these fields to be 6,524, 8,160 and 6,203 in 2014, 2015 and 2016 respectively. There exists, then, a sizeable gap between job demand and degree production. Employer demand clearly exceeds the regional supply of graduates with relevant degrees

However, because BC used a broad range of SOC’s in making its labor market case, we supplement the aforementioned program completion-employer demand gap data with a more

¹⁸ See appendix F which offers a working draft schedule of courses for the BAS ROBAI program.

expansive review of academic programs and job openings. This adds, in our view, a greater dose of objectivity and will account for the likely possibility that a portion of robotics and AI jobs will be filled by IT professionals other than robotics and AI specialists. In doing so, BC offers a more instructive account of program completion-employer gap data.

To its original program list, BC added four new disciplines that might supply graduates for robotics and AI jobs. The program search, as reconstituted, included robotics technology, mechatronics, robotics and automation, artificial intelligence, computer science, computer software engineering, computer systems analysis/analyst, application computer programming, and computer and information sciences. This eight academic program search revealed 10 institutions in King County that produced 687 degree completions for 12,029 openings in 2016.¹⁹ This data demonstrates a sizeable gap between the number of graduates produced and annual job openings. More important, even if one uses only the annual job openings specific to robotics and AI—6,203 for 2016—one still observes that employer demand exceeds the regional supply of graduates by a considerable amount. This gap is compounded even further when one accounts for the fact that of this larger pool of degree completions, 196 were Master’s degrees, 16 were Ph.Ds. and 14 were post-baccalaureate certificates. Bachelor degree completions comprised only 461 of the total completions. Since the annual job openings figures were based on bachelor degree qualifications, we believe this indicates that there is opportunity and capacity for increased production of bachelor degrees in robotics and AI.

University of Washington Degree Completion in fields related to robotics and AI				
Year	Bachelor Degree Completions	Master Degree Completions	Total Completions	Annual Job Openings
2016	26	19	45	6,203
2015	23	27	50	8,160
2014	32	0	32	6,524
TOTALS	81	46	127	

Table II

Strong Foundation Built on Existing Programs:

Bellevue College’s existing foundational programs

The BAS degree in Robotics and Artificial Intelligence will be built upon an existing AAS-T degree in Information Systems and the new AAS-T degree in Robotics and Artificial Intelligence, which is a program option residing under the information systems degree. Descriptions of these existing feeder programs follow below.

¹⁹ See table in Appendix J –Supply-Gap rubric

Information Systems, AAS-T

The Information Systems degree prepares graduates for entry-level developer/analyst positions and for continuation to a baccalaureate institution. Concentration includes software development or business intelligence.

Robotics and Artificial Intelligence, AAS-T

The Robotics and Artificial Intelligence degree prepares graduates to work in the field of robotics and AI application development. The program provides students with the knowledge and skills to design, implement and analyze basic machine learning and embedded systems that run robotics and AI applications. The program introduces students to the science of computer vision and the fundamentals of robotic control systems.

Table III below shows the FTE enrollments in BC's Information Systems AAS-T program over a five year period. FTE has grown 74% over this period.

Department	2012-13	2013-14	2014-15	2015-16	2016-17
Info. Systems	139.2	193.0	226.2	245.1	242.2

Table III

Equally telling is the student headcount for the Information Systems program. Table IV below shows significant growth in the total number of students enrolling in this degree program over a 5 year period.

Academic Year / Select Column						
2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Comple..	Comple..	Comple..	Comple..	Comple..	Comple..	Comple..
778	738	722	1,020	1,087	1,253	1,262

Table IV

Collaboration and synergies with existing BAS and AAS-T degrees at Bellevue College

By building upon existing programs, BC can capitalize on clear synergies between the aforementioned associate degrees and this new BAS degree in Robotics and Artificial Intelligence. During its curriculum development phase and once fully established, the BAS degree will leverage these synergies to provide seamless transition for students between programs.

In addition, clear synergies exist among courses within several of BC's established BAS degree programs. For example, upper division information systems and predictive analytics courses from the BAS in Information Systems, or the BAS in Data Analytics may be incorporated into the BAS degree in Robotics and Artificial Intelligence. What's more, although the majority of its courses at the 300 and 400 level will be new, the robotics and AI program will likely share existing general education courses created for BC's other BAS programs. In this way, state and

program resources will be used efficiently.

Student Demand

Robotics and AI degree addresses unmet student needs

This BAS degree in Robotics and Artificial Intelligence meets critical student needs in a number of ways.

First, as it stands today, no college or university within the state offers a specialized bachelor degree in robotics and AI. Expressed demand for applied and specialized education in robotics and AI is going unmet; BC's proposed program will begin to fill this void.

Second, the opportunity for professional/technical associate degree students to earn a traditional bachelor's degree is limited. This specialized BAS degree will serve as an efficient, guided pathway to a bachelor's degree for students who might not otherwise have such an opportunity.

Third, as an applied degree, BC's program will teach critical skills identified by employers as essential abilities, helping graduates launch careers quickly and effectively.

Fourth, computer and information systems working professionals who do not have a bachelor's degree can earn the degree while simultaneously strengthening skills for their present duties.

Finally, this BAS degree will afford place-bound students whose family or financial obligations constrain transfer to outlying universities a chance to earn a bachelor's degree.

Student Survey

During the fall of 2017, BC conducted a survey of its own students as well as students from seven other SBCTC colleges. The additional colleges included North, Central and South Seattle colleges, Green River College, Highline College, Lake Washington Institute of Technology and Cascadia College. A total of 94 students completed the survey. The survey indicated strong support for development of this BAS program.

When asked about interest in a BAS degree in Robotics and Artificial Intelligence, respondents expressed strong support for the development of such a program. 42% of those surveyed (37 of 94) said that they had definite interest in attending the BAS program. Another 39% (34 of 94) stated that this program might be of interest. Students from Lake Washington, Green River and BC showed the greatest interest. 60% of Lake Washington students (3 of 5), 59% of Green River of students (10 of 17) and 48% of BC students (14 of 29) responded "yes" they would be interested such a program.

Below are some other key findings of this survey.

As to why they were interested, students responded that the new degree would provide opportunity to:

- Increase their chances of finding a job (53%),
- Explore a new field (51%),
- Seek promotion (16%),

- Develop their skills for their current work (16%).

As to what would influence their decision to enroll, respondents answered:

- It would be affordable (51%)
- It was close to where they live or work (32%)
- It would provide opportunity to transfer for a 2 year degree into a bachelor's degree (54%)
- It would provide opportunity to attend graduate school. (39%)
- Some classes would likely be online (27%)

Collaboration with other professional/technical feeder programs

Eight Washington State Community and Technical Colleges within Bellevue's region have professional/technical or other transfer degrees in fields such as computer programming, Information processing, engineering, computer science, computer technology, or computer and information systems. These programs might serve as feeder programs to this BAS degree in Robotics and Artificial Intelligence. Table V and VI below show enrollments and completions for programs related to these fields during the 2015-16 academic year. BC's proposed robotics and AI program will provide students enrolled in associate degree programs of these kinds the opportunity to pursue a fully dedicated robotics and AI bachelor program, an opportunity that does not currently exist in Washington State.

# Students	Academic Year 2015-16									
	Bellevue College	Cascadia Community College	Edmonds Community College	Green River College	Lake Washington Institute of Technology	Renton Technical College	North Seattle College	Seattle Central College	South Seattle College	Total
Comp Sys Network/Telecomm	314	49	81	10	164	120	142	115	61	1,056
Computer Graphics	223		31		161					415
Computer Program, Product			8				75			83
Computer Programming	458	75	65	61	168	191	42	119		1,179
Computer Science					2					2
Computer Sciences				1	3		52			56
Data Warehouse & Db Admin	215	4	44					27		290
Engineering Tech, Genl			228		16					244
Information Processing	70		178	1	5		12		38	304
Information Technology						28				28
Microcomputer Apps, Genl	21		85	53	124					283
Robotics Technology			1				5			6
Total	1301	128	721	126	643	339	328	261	99	3,946

Source: MRTE. Using CIPs - 110(computer science); 1419(mechanical engineering); 114(mechanical robotics); 1500(engineering). unduplicated headcount.
Source: MRTE - For B56; SBCTC Credential Dashboards for B56 & B67.

TABLE V

College	Applied Science AAS-T	AS-T Track 1	AS-T Track 2	Bio/ CChem Eng AS-T/ MRP	Comp / Elec Eng AS-T/MRP	Mech, Civil, Aero, Ind & Mat Eng AS-T/MRP	Technology DTA/MRP	Total
Bellevue	172	45	59	4	5	10		295
Cascadia	18	18	39		2	4		81
Edmonds	57	24	50	5	4	15		155
Green River	47	41	108					196
Lake Washington	179						1	180
Renton	92							92
Seattle Central	99	28	87					214
Seattle North	75	21	70					166
Seattle South	54	13	59			3		129
Total	793	190	472	9	11	32	1	1,508

Source: SBCTC - Credential Dashboard.

Table VI

Projected Program Enrollments:

Based on survey data, information on possible feeder programs, projected enrollments for the new AAS-T in Robotics and AI (See table VII) and the enrollment histories of its other BAS degree programs, BC projects the following enrollments for this program during the next five years. (See Table VII below) Since robotics and AI are new and emerging fields, BC anticipates small enrollments as students and industry come to grips with how these field will impact the economy and jobs. After the 5 year mark, BC anticipates that program growth will accelerate upward.

AAS-T projected enrollment Goal for annualized FTEs:

AY 18-19	AY 19-20	AY 20-21	AY 21-22	AY 22-23
8	12	15	18	20

Table VII

The AAS-T program seeks to produce 12 graduates per year after AY 22-23.

Projected FTE Enrollments for BAS degree in Robotics and Artificial Intelligence					
Year	AY 2019-20	AY 2020-21	AY 2021-22	AY 2022-23	AY 2021-22
Headcount	8	12	18	21	24
FTEs	6	8	12	14	16
Graduates		2	4	6	8

Table VIII

Conclusions:

Given industry's investment in robotics and AI initiatives, student survey data, BC's enrollments in its associate degree program in information systems, enrollments in potential feeder programs, and the potential of this degree to capitalize on an impending economic and technological revolution, it is evident that there is a solid student base on which to build the program.

Maximizing state resources:

BC's proposed applied bachelor's degree in robotics and AI will provide students the opportunity to earn an affordable bachelor's degree focused on the knowledge and skills sought by employers. The program will benefit the state and maximize its resources by:

- Increasing the total number of bachelor's degree recipients in the state, assisting the state to reach its baccalaureate completion targets as well as fill critical, emerging workforce shortages.
- Serving professional and technical associate degree recipients who have limited options to transfer to traditional bachelor's degree programs.
- Providing opportunities for place-bound students, increasing the pool of local talent from which employers can hire workers.
- Offering working adult students online or hybrid modality classes that will contribute to efficient use of resources and classroom space.

- Using upper-division BAS electives and general education courses already offered through BC's other baccalaureate programs to increase course fill rates and realize cost-efficiencies.
- Creating a self-support program that induces efficient use of resources.

Unique aspects of proposed program

BC's proposed BAS degree will be the first fully-dedicated robotics and AI baccalaureate program in the state of Washington. While the University of Washington offers a Bachelor of Science in Mechanical Engineering with a concentration in mechatronics and a Master's degree in Computer Science with an emphasis in AI, these degrees do not treat robotics and AI as a distinctive discipline. BC's program will embrace robotics and AI as a singular, emerging field and teach all content with this understanding in mind.

Collaboration with the Center of Excellence for Computer and Information Technology (CoE of ICT)

As described in the introduction, the origin of this proposed degree was a joint effort of the CoE of ICT and BC. Together, these organizations conducted the initial research on the impending robotics and AI revolution, culled the workforce and student demand data, and organized two employer focus groups. The CoE of ICT has also worked closely with BC faculty in devising a working curriculum that was presented to IT experts for evaluation and assessment. This working curriculum will serve as the foundation for the program proposal should the SBCTC give BC approval to begin development of the program.

Important to note, the CoE of ICT has not only been an active partner, but also a champion of developing a degree in robotics and AI. The CoE of ICT's website stores a wealth of data and research on the robotics and AI revolution, and has devoted considerable time and space to this topic on its public blog and podcasts. The CoE of ICT has strongly encouraged BC to undertake the development of this degree and has pledged to continue its partnership during the development stages of the degree should BC gain the go-ahead from the SBCTC.

Collaboration with CTC BAS Programs and universities

During the past academic year (AY 17-18), BC announced its intent to offer this BAS degree at the SBCTC Baccalaureate Leadership Council meetings of October 10, 2017, January 30, 2018 and May 7, 2018. Subsequent to these meetings, BC has forwarded its Intent to Offer the Degree document along with the working curriculum to Lake Washington Institute of Technology, Green River College, and Renton Technical College. No SBCTC college has raised an objection. BC intends to engage these colleges throughout the development phases of the degree.

Since its proposed program is unique, having no counterpart at other SBCTC colleges, BC will have to work closely with other SBCTC colleges to assure smooth transition between their computer and information systems-related programs and BC's proposed robotics and AI program. At present, there may not be "seamless" transition between programs. When developing the curriculum, BC will have to set up a series of transition plans that will enable

students from other colleges to transfer and complete BC's new program in a timely manner. In time, BC will work to develop articulation agreements with various SBCTC colleges so that students will have a clear pathway into the BAS in Robotics and Artificial Intelligence.

BC also shared its Intent to Offer the Degree document with the computer science departments of the University of Washington's Seattle and Bothell campuses (UW), and with Northeastern University's Computer Science and department. Dr. Hank Levy, the Chair of UW's Seattle computer science program, Drs. Munehiro Fukuda and William Erdly of UW's Bothell Computer Science department and Dr. Paula Boyum of Northeastern University's Seattle Campus were contacted directly by BC. While the UW's computer science programs have not yet responded to BC's request for feedback, BC did receive a positive response letter from the University of Washington's Provost Office. Appendix K contains the text of this response letter.

As it continues to develop its Robotics and AI degree, BC will continue to reach out to the University of Washington for advice and assistance. However, BC wishes to note that it does not anticipate much collaboration on this front. BC's workforce BAS degree will not articulate well to UW's various Master's programs in Computer Science and Engineering, where the concentration in AI resides, because math and hardware requirements differ greatly between the programs.

BC did begin open discussions with Northeastern University. In the past, BC and Northeastern have established articulation agreements between BC's computer science and information systems bachelor degree programs and Northeastern's Master's degree in Computer Science. BC has asked Northeastern to undertake a full review of its robotics and AI curriculum over the course of the next several months to assess whether the new BAS program in Robotics and Artificial Intelligence can be added to the established articulation agreement.

With respect to collaboration and articulation, one final point needs to be addressed. New and emerging STEM fields typically originate with research and development conducted at the Ph.D and Master's level. Bachelor level study within such fields begins only as the science matures. This was true, for example, of Computer Science, and it will be true of Robotics and AI. Thus, BC believes that robotics and AI has reached a "tipping point" where the work will increasingly be performed by graduates trained at the bachelor level. Students who are interested in the field will not be required to pursue graduate level work. Rather, the work will become routinized and simplified, more easily grasped and performed by bachelor degree graduates. Therefore, BC's BAS degree in robotics and AI should be a small, but significant contributor to the evolving workforce in these emerging fields.

Conclusion

BC looks forward to speaking with SBCTC system trustees about our plans for an applied baccalaureate degree in robotics and AI. We are excited about this opportunity to build on our strong associate degree programs and partnerships with employers. The BAS in Robotics and Artificial Intelligence will provide a new option for professional/technical associate degrees graduates, meet transfer needs of community college students at BC and other systems colleges, and be tailored specifically to address the unique employer needs of the Puget Sound region.

Appendix A

EMSI Robotic/AI Job Descriptions Samples

Software Design Engineer II

Location: Redmond, WA

O*NET: 15-1132.00

Company: Microsoft Corporation

Job Title: Software Engineers

AI technologies are prevalent in the consumer space. Your favorite search engine, video recommendation service, shopping site, etc. are using AI-based technologies to become more useful & relevant than ever. In the AI+R (Artificial Intelligence + Research) division, we are starting a new sub-division to re-imagine enterprise scenarios using AI. If delighting enterprise customers, building large-scale cloud services, working with the latest technologies in a fun & growing team, and adding to the company's bottom line excites you - this opportunity may be for you! Intelligent conversation systems and their business application is a growing area of innovation within the software industry. Cutting edge research in this space leverage ML & related techniques have made it easier to solve real-life business problems such as customer contact management, online support etc. Our team has successfully built the early technology stack to be able to offer online virtual-assistants for customer support agents & end customers. This are based on the latest research from the fields of deep learning, reinforcement learning, machine comprehension, and latest Microsoft technologies such as the Microsoft Cognitive Services, Bot framework, Azure, etc. This technology currently powers many of Microsoft's online support scenarios. We are rapidly growing our team to expand the technology stack and offer it to our external customers. We are looking for a Senior Software Engineer to help design/implement scenarios related to the foundation/infrastructure/extensibility stack.

Core Responsibilities:

- Design, implement and deliver core components and experiences to enable scenarios related to foundation/infrastructure/extensibility.
- Work with partner teams across the division to help meet the engineering goals.

Qualifications:

- 3+ years of experience designing, building, and successfully releasing software services/products.
- 1+ year experience with cloud-scale services and/or server/service management features.

Preferred Qualifications:

- Masters/**Bachelors** degree in computer science (or related field), or equivalent industry experience.
- Experience with building cloud-scale infrastructure components.
- Familiarity with AI technologies.
- Ability to meet Microsoft, customer and/or government security screening requirements are required for this role. These requirements include, but are not limited to the following specialized security screenings:

Microsoft Cloud Background Check:

This position will be required to pass the Microsoft Cloud background check upon hire/transfer and every two years thereafter. Microsoft is an equal opportunity employer. All qualified applicants will receive consideration for employment without regard to age, ancestry, color, family or medical care leave, gender identity or expression, genetic information, marital status, medical condition, national origin, physical or mental disability, political affiliation, protected veteran status, race, religion, sex (including pregnancy), sexual orientation, or any other characteristic protected by applicable laws, regulations and ordinances. If you need assistance and/or a reasonable accommodation due to a disability during the application or the recruiting process, please send a request to askstaff@microsoft.com.

Principal Software Engineer

Location: Redmond, WA

O*NET: 15-1132.00

Company: Microsoft Corporation

Job Title: Software Engineers

Loop Studio is a small, agile and highly autonomous engineering team in the **Artificial Intelligence & Research division**. We believe that by engaging deeply with our users and iterating quickly we can build products that people love. We are developing products that use AI and computer-vision technology to enable organizations to extract insights and intelligences from video feeds. We built the following Android applications, which are best in category and representative of our beliefs in a customer-centric engineering model: Next Lock Screen. #1 ranked "Lockscreen" in the Android Play store <https://blogs.microsoft.com/firehose/2015/02/12/updates-to-the-next-lock-screen-show-microsofts-commitment-to-customer-driven-innovation>; Microsoft Launcher. #1 ranked & "Launcher" in the Android Play Store <https://www.windowscentral.com/microsoft-launcher-turns-your-android-phone-sexy-beast-it-could-be-even-better>; In building these applications, we have developed a strong point of view on how best to do iterative innovation. By connecting deeply with users to drive product direction we have built products that customers love. In addition to innovating on product we have also innovated on culture and engineering process within Microsoft. With a team lead with deep experience in the startup world, we embody the customer obsession, agility, flat structure, and bias for action that is necessary to build great products from scratch. We love open-source and are extensive users & contributors of Docker, Node.

JS, Redis, Kafka, etc. We pride ourselves on having a culture that supports and fosters psychological safety, and we're all passionate about showing up with our best selves. In short, we are keen to come into work on Monday and build something awesome as a team.

You can read more here:

<http://news.microsoft.com/features/meet-loop-the-team-at-microsoft-behind-arrow-changing-the-way-they-work-to-make-a-big-impact>; There are more than 300 million video cameras currently installed in the world and we believe that it is possible to use that infrastructure to make the world a better place. Using state of the art computer vision technology we will enable organization to extract rich and actionable intelligence from those video feeds to enable data-driven decisions making. Initially we will focus on scenarios in the Smart City sector, but believe that what we are building will benefit many other sectors as well, including security, manufacturing, autonomous vehicles, farming, safety and transportation. We're looking for a few exceptional people to join our team and help make these projects a home run. We prefer people with previous experience in either computer vision or AI development, who can help us learn and execute more quickly in this space. However, we are open to engineers that are open to learning and have shown a track record of ramping up in new areas quickly.

RESPONSIBILITIES

- Develop prototypes to help to visualize and expand new ideas and concepts.

- Work with the rest of the team to define and meet key milestones as well as create task lists and work estimates.
- Help to refine our machine learning pipeline to increase automation and ensure efficiency and more productive workflows.
- Create tools, samples, and documentation against the work you do.
- Must thrive in a highly ambiguous environment, with high levels of autonomy.

REQUIREMENTS

- **Bachelor's degree** OR 10+ years of Industry experience in technical role
- Strong passion for delivering highly quality, scalable products.
- Strong verbal and written communication skills with excellent interpersonal communication and collaboration skills
- Experience in building infrastructures and services at web scale.

BEYOND TECHNICAL APTITUDE, YOU WILL NEED TO DEMONSTRATE

- An entrepreneurial attitude. While we value deep specialization, team members wear many hats and work cross-discipline to have the maximum impact.
- Laser-focus on customers and results. Hypothesize, prove, ship and learn. We need someone who can keep the team hyper-focused on top user problems, opportunities and prove the solutions as quickly and creatively as possible.
- Adaptability to diverse problem-solving skills. This team moves fast and your role will be to help unblock barriers.
- Balance agility + scale.

You should equally be comfortable building prototypes or proof-of-concepts as well as longer-term architecture. Microsoft is an equal opportunity employer. All qualified applicants will receive consideration for employment without regard to race, color, sex, sexual orientation, gender identity or expression, religion, national origin or ancestry, age, disability, marital status, pregnancy, protected veteran status, protected genetic information, political affiliation, or any other characteristics protected by local laws, regulations, or ordinances..

Software Development Engineer

Location: Seattle, WA

O*NET: 15-1132.00

Company: Amazon.com, Inc.

Job Title: Software Development Leaders

Are you inspired by **the fusion of software and robotics**? Are you a software engineer who dreams of building solutions that combine the latest technology in Robotics, Machine Learning, Computer Vision, AWS services to change how millions and millions of customer orders are fulfilled? Answer yes to any of these and you've got to check us out! Amazon Robotic Application team is seeking Software Engineers who are fascinated by solving real world fulfillment challenges at Amazon scale. You'll be a key member of a software engineering team that designs, prototypes, builds, integrates, tests, launches and runs automated Robotic and mechatronic applications throughout Amazon's fulfillment centers. This is an early stage initiative with a fast paced, highly collaborative start up like environment inside Amazon. To be successful you need to be flexible and entrepreneurial. You are a true owner - you are hands on and you lead by example. You develop software to direct physical machines and make them work more efficiently. You partner with hardware engineers, solution designers, applied scientists, and project managers effectively. You acquire expertise as needed, iterate and adapt your approach as you learn more. You create extendable design and easy to maintain technical solution with the long term vision in mind. Bachelor's degree in Computer Science or related technical discipline 3+ years software engineering experience, including Java and/or C/C++ 3+ years of experience building successful products 3+ years of working knowledge of software engineering best practices for full software development life cycle, including coding standards, code reviews, design patterns, source control management, build processes, testing, and operations Excellent verbal and written communications Master's or Ph.D degree in Computer Science or related technical discipline Experience in building high-performance, highly-available and scalable distributed systems Experience in building Robotic or automation related products.

Experience in supply chain optimization.

Experience with mentoring junior software engineers Experience influencing software engineer's best practices within your team Hands on experiences in many disparate technologies and emerging platforms Ability to learn new technologies quickly Amazon is an Equal Opportunity-Affirmative Action Employer – Minority / Female / Disability / Veteran / Gender Identity / Sexual Orientation.

Software Development Engineer

Location: Bellevue, WA

O*NET: 15-1132.00

Company: Amazon.com, Inc.

Job Title: Software Development Leaders

Amazon Lab126 is an inventive research and development company that designs and engineers high-profile consumer electronics. Lab126 began in 2004 as a subsidiary of Amazon.com, Inc., originally creating the best-selling Kindle family of products. Since then, we have produced groundbreaking devices like Fire tablets, Fire TV, and Amazon Echo. What will you help us create?

We are a smart team of doers that work passionately to apply **cutting-edge advances in robotics and software** to solve real-world challenges that will transform our customers' experiences in ways we can't even imagine yet. We are looking for an intrepid problem-solver to dive into an ambiguous problem space and design and deliver innovative software solutions, and to collaborate with cross-functional engineering teams, including Amazon Robotics, to put the concepts you develop into production. As an SDE, you will have the opportunity to build cutting-edge software around developer experience, in particular build and deployment automation for new devices. You will be working with a unique and gifted team developing exciting products for developers and testers. The team is a multidisciplinary group of engineers and scientists engaged in a fast-paced mission to deliver the new products. You should be comfortable collaborating in a fast-paced and often uncertain environment, and contributing to innovative solutions, while demonstrating leadership, technical competence, and meticulousness. If you join us, your opportunities will include:

- Help develop and maintain build infrastructure critical to the success of an exciting new device.
- Define and deliver great developer experiences and tools.
- Deliver high quality software through working in a dynamic, team-focused Agile/Scrum environment. .
- BS/MS in Computer Science or equivalent
- 3+ years of industry experience
- 2+ years of programming experience in Python, Java or C++ in Linux
- Experience creating architecture and sustainable solutions Preferred Qualifications
- Passion for automating away routine tasks to help improve developer productivity
- Experience with standard Unix build tools like make and cmake
- Experience with Docker and ECR
- Experience driving and articulating technical challenges and solutions
- Experience working in an Agile environment Lab126 is part of the Amazon.

com, Inc. group of companies and is an Equal Opportunity-Affirmative Action Employer – Minority / Female / Disability / Veteran / Gender Identity / Sexual Orientation

Software Development Engineer

Location: Bellevue, WA

O*NET: 15-1132.00

Company: Amazon.com, Inc.

Job Title: Mobile Software Engineers

The Amazon Devices team designs and engineers high-profile consumer electronics, including the best-selling Kindle family of products. We have also produced groundbreaking devices like Fire tablets, Fire TV, Amazon Dash, and Amazon Echo.

The Role:

We are a smart team of doers that work passionately to apply cutting-edge advances in robotics and software to solve real-world challenges that will transform our customers' experiences in ways we can't even imagine yet. We are looking for an intrepid problem-solver to dive into an ambiguous problem space and design and deliver innovative software solutions, and to collaborate with cross-functional engineering teams, including Amazon Robotics, to put the concepts you develop into production.

As an SDE, you will have the opportunity to build cutting edge software around customer experience, cross device APIs or cloud services, frontend and backend technologies. You will be working with a unique and gifted team developing exciting products for consumers. The team is a multidisciplinary group of engineers and scientists engaged in a fast-paced mission to deliver the new products. You should be comfortable collaborating in a fast-paced and often uncertain environment, and contributing to innovative solutions, while demonstrating leadership, technical competence, and meticulousness. If you join us, your opportunities will include:

- Invent a delightful experience for our customers that utilizes Android, Alexa technologies, cloud services, frontend and backend technologies.
- Define and implement novel customer experiences and product direction through collaboration with Product, UX teams and other engineering teams.
- Deliver high quality software through working in a dynamic, team-focused Agile/Scrum environment
- BS/MS in Computer Science or equivalent
- 7+ years of industry experience
- 7 years of programming experience in Java or C++; in Linux, Windows, and/or Mac environment
- 5+ years of CS fundamentals including data structures, algorithms, run-time analysis, object oriented design and code quality verification
- 2+ years of experience building applications on mobile platforms
- Passion for inventing new product designs and technical solutions.

- Experience building applications for Android platform
- Experience driving and articulating technical challenges and solutions.
- Experience creating advanced architectures and sustainable solutions.
- Experience collaborating with UX, Product, and non-technical partners.
- Experience working in an Agile environment.
- Experience on cloud and back end technologies.

Amazon is an Equal Opportunity-Affirmative Action Employer – Minority / Female / Disability / Veteran / Gender Identity / Sexual Orientation.

(USA-WA-Kirkland) Engineering Resident, University Graduate (Fixed-Term Employee)

Location: Kirkland, WA

O*NET: 15-1132.00

Company: Google Inc.

Job Title: IT Support Engineers

Note:

By applying to this position your application is automatically submitted to the following locations: Kirkland, WA, USA; New York, NY, USA; Seattle, WA, USA; Mountain View, CA, USA We are accepting applications for our 2018 programs. Cohort start dates are in March, July and September 2018 and applicants must have received their degree prior to the cohort start date. Google's software engineers develop the next-generation technologies that change how billions of users connect, explore, and interact with information and one another. Our products need to handle information at massive scale, and extend well beyond web search. We're looking for engineers who bring fresh ideas from all areas, including information retrieval, distributed computing, large-scale system design, networking and data storage, security, artificial intelligence, natural language processing, UI design and mobile; the list goes on and is growing every day. As a software engineer, you will work on a specific project critical to Google's needs with opportunities to switch teams and projects as you and our fast-paced business grow and evolve. We need our engineers to be versatile, display leadership qualities and be enthusiastic to take on new problems across the full-stack as we continue to push technology forward. Google aspires to be an organization that reflects the globally diverse audience that our search engine and tools serve. We believe that in addition to hiring the best talent, a diversity of perspectives, ideas and cultures leads to the creation of better products and services. Google is invested in increasing the pipeline of Computer Scientists and Software Developers, particularly those who are historically underrepresented in the field. Many aspiring Computer Scientists could benefit from a program that bridges the gap between academia and industry. The Engineering Residency Program is committed to addressing diversity in our company and in the technology industry. The Google Engineering Residency Program is a 12-month fixed term role designed to jumpstart your career as a software engineer at Google. The Engineering Residency Program is a developmental program open to all qualified graduates who have received a degree in Computer Science or Computer Engineering. The program combines CS education with hands-on software engineering experience in a supported, closely mentored cohort. In addition to an intensive industry-focused training period, the Engineering Residency Program provides Residents with a strong foundation in CS (as it applies to real engineering problems) and experience working on complex programming projects with Google engineers. The goal of the Residency Program is to help Residents become productive and successful software engineers within the one year program.

- Make the transition
- The professional engineering environment is constantly evolving. Google's Engineering Residency Program is specifically designed to accelerate the transition from school to industry
- enabling Residents to have an impact right away.
- Learn new skills

- At Google, our infrastructure is really complex. As an Engineering Resident, you'll learn the things that are harder to teach in school
- from large-scale distributed processing and Google-style test-driven development, to applied theory and code reviews, to developer workflow and beyond.
- Grow with peers
- The cohort experience can be a powerful one. With such a diverse set of backgrounds and perspectives, your peers will provide you with opportunities for learning and development throughout the program
- and they'll serve as a lifelong network.
- Kickstart your career
- This opportunity is unique. As an Engineering Resident, you'll have the ability to build technical skills, adjust to industry work, leverage a built-in support network, and access mentorship opportunities
- all of which will kickstart your career in tech.
- Change the world
- Google's software engineers develop the next-generation technologies that change how billions of users connect, explore, and interact with information and one another.
- Participate in an initial training period (lasts eight weeks). Engineering Residency combines interactive group learning with training on Google tools, technologies and best practices.
- Following the training period, residents are placed in up to two five-month rotations. During the rotational period, residents are embedded on Engineering teams across the company; work side-by-side with engineers on important, real-world projects that are core to Google.
- Work on specific projects critical to Google's business needs based on your technical experience. These opportunities exist across multiple groups within Google.
- Be versatile, display leadership qualities and be enthusiastic to handle new problems across the full-stack as we continue to push technology forward in all areas.
- Train throughout the year by attending sessions taught by Google engineers, working with technical mentors, and partnering with peers in their cohort on challenging group engineering projects. Before the end of their residency year, Residents will be considered for full-time positions on Google Engineering teams, based on performance. ## Qualifications Minimum qualifications:
 - Bachelor's degree in Computer Science, Computer Engineering, a related technical field, or equivalent practical experience.
- Completion of related Computer Science coursework and ability to start no later than September 2018.

Oculus Research VR/AR Software Engineer

Location: Redmond, WA

O*NET: 15-1132.00

Company: Facebook, Inc.

Job Title: Software Engineers

(Redmond, WA) Careers at Oculus Part of Facebook You're a Software Engineer with a deep C++ skill set and a passion for working on breakthrough new technology. You're also a 3D math whiz with a background in real time systems such as games. You love solving novel problems from first principles. You're always on the lookout for better, faster, and smaller solutions. You enjoy working at all levels of the software stack, from device drivers to operating systems, core libraries to user interfaces.

At Oculus Research, you'll build cutting-edge research prototypes that explore the future of virtual reality (VR) and augmented reality (AR). Join a world-class team experimenting with bold ideas in areas including optics, haptics, tracking, displays, computer vision, user experience, audio, and perceptual psychology. Work alongside expert Scientists, Mechanical Engineers, Electrical Engineers and Software Engineers to create the technology that makes VR and AR pervasive and universal.

Join the adventure of a lifetime as we make science fiction real and change the world. Responsibilities

- Analyze, design, develop and debug real time VR and AR software for advanced prototypes and user experiences.
 - Collaborate in a team environment across multiple scientific and engineering disciplines, making the architectural tradeoffs required to rapidly deliver software solutions
 - Develop software for a variety of consumer devices, including novel sensing systems, tracking systems, imaging systems and haptic devices
 - Write clean readable code, debug complex problems that span systems, prioritize ruthlessly and get things done with a high level of efficiency
 - Learn constantly, dive into new areas with unfamiliar technologies, and embrace the ambiguity of VR problem solving
- Minimum Qualifications
- **BS degree in Computer Science or related field**
 - 3D math and linear algebra skills
 - 5 or more years C++ experience and used professionally in the last 2 years, including modern C++ features
 - 5 or more years experience creating software for games or other real-time environments.
 - Proven track record of software development, including shipping one or more products.
 - Problem solving and optimization ability

- Demonstrated experience working across disciplines to drive optimal solutions Preferred Qualifications
- Experience in 3D graphics
- Experience working on Unreal or Unity game development engines
- Expertise in Physics, Optics, Computer Vision,
- Robotics, Sensor Fusion, or Machine Learning technology Research as of principles required Engineers.

Senior or Lead Software Engineer, Performance (Tech & Products)

Location: Bellevue, WA

O*NET: 15-1132.00

Company: Salesforce.com, Inc.

Job Title: Software Engineers

Software Engineer, Performance (All levels) Locations where we are hiring: San Francisco, CA | Bellevue, WA

- relocation support provided The role: We are seeking a Software Engineer, Performance to join our R&D, Tech & Products team.

As the 4th largest software company in the world, and the leader in the cloud, we are challenged with designing and developing the next generation technologies in cloud computing. Our mission as the "customer company", is to ensure trust with our customers, from Fortune 100 companies, to start-ups and nonprofit organizations. Processing more than 5+ billion transactions per day and growing, performance remains a center focus for innovation. Trust.salesforce.com is the Salesforce community's home for real-time information on system performance and security. View our daily transaction volume here: <https://status.salesforce.com/performance>

com/performance Your impact:

Be a part of the first-rate team that influences the future expansion of next-generation cloud solutions for speed, scale, and high availability. You will have the opportunity to design performance experiments, collect and analyze data. Develop power tools and automation frameworks for continuous integration, performance measurement and analysis. Contribute to the design and velocity of our global products. Optimize our systems end-to-end by advising infrastructure design, server and application development/ tuning, solving complex cluster architecture and data storage challenges that impact **features within artificial intelligence**, IoT, Platform, API's and mobile UI experiences. If you're fired up about software performance, automating everything, and working with great engineers, this is the job for you! If you are a developer that is passionate about performance, or a performance tester that is also interested in contributing performance improvements, we would love to hear from you. This candidate must have the technical prowess to write fast and efficient code, find inefficiencies and influence others to make performance improvements. In addition, this engineer needs to measure and demonstrate performance gains in a scientific way, by building/running workloads or simulations. The candidate should be confident in discussing time/space complexity using $O(n)$ notation and engage in a project's design phase for its performance and scalability considerations. You are the performance expert for your scrum team, and should own your team's performance related problems on production.

Desired Skills:

- 6+ years of software development experience (Java preferred)
- 3+ years in performance engineering

- Strong programming skills in Java and profilers
- Hands-on experience with performance measurement, analysis, and optimization
- Experience conducting benchmark and/or work-load testing using automation tools and frameworks for performance measurement and analysis (Jmeter)
- Experience performing simulation or lab experimentation to analyze application/ system performance
- Distributed systems debugging
- Ability to work cross-functionally to articulate, measure and solve performance issues
- Passion for continuous improvement in building knowledge base technically and professionally
- **Bachelor's degree** (or its foreign degree equivalent) in Computer Science, Engineering, or a related technical discipline.

Preferred Skills:

- SaaS experience at scale
- Knowledge of database fundamentals: SQL, schema, internals (Oracle preferred, TKProf, AWR, ASH)
- JVM and garbage collector tuning, heap dump analysis experience
- Experience with the following performance tools: JMeter, YourKit
- Experience in using UI profilers and deep understanding of chrome developer tools
- Understanding of how a browser works (i.e. chromedevtools, ui automator)
- Hands on Experience in javascript, React and NodeJS
- Agile/ Scrum methodology experience
- Experience with big data technologies such as Hbase, HDFS, Hadoop, Pig, Hive and/or Kafka
- Experience working in an Apache/ Spark architecture
- Knowledge of back-end systems and API's, developer tools and compilers
- Knowledge of statistical analysis and experimental design techniques
- Working knowledge of Linux operating system
- Experience analyzing and interpreting large volume of production data using Splunk to understand throughput, latency, memory and CPU utilization Salesforce, the Customer Success Platform and world's #1 CRM, empowers companies to connect with their customers in a whole new way.

The company was founded on three disruptive ideas: a new technology model in cloud computing, a pay-as-you-go business model, and a new integrated corporate philanthropy model. These founding

principles have taken our company to great heights, including being named one of Forbes's "World's Most Innovative Company" six years in a row and one of Fortune's "100 Best Companies to Work For" nine years in a row. We are the fastest growing of the top 10 enterprise software companies, and this level of growth equals incredible opportunities to grow a career at Salesforce. Together, with our whole Ohana (Hawaiian for "family") made up of our employees, customers, partners and communities, we are working to improve the state of the world.

- LI-Y
- LI-CW1 architecture Jmeter.

Appendix B

Sampling of Indeed.com

Recent Job Postings in Robotics and Intelligence

What

robotics OR "Artificial Intelligenc

Where

Bellevue, WA

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Intelligence AI jobs in
Bellevue, WA**

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[15 new](#)

[robotics OR "Artificial Intellig... - Bellevue, WA OR Redmond OR Seatte](#)

[artificial intelligence - Bellevue, WA](#)

[embedded software engineer - Bellevue, WA](#)

[Bellevue, WA](#) -

Cognitive/Robotics Automation Architect

[IBM](#) - [21,902 reviews](#) - [United States](#)

Creating end-to-end automation solutions utilizing all of IBM's capabilities in Cognitive/Watson, Artificial Intelligence, Machine Learning and Robotic Process...

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Machine Learning AI - Bellevue, WA - Locals Only

[Tech Observer](#) - [13 reviews](#) - [Bellevue, WA](#)

Architect, design, and optimize Cloud AI platform frameworks. 2+ year experience in AI frameworks or Cloud platforms....

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Software Engineer (3D graphics, MR/VR/AR)

[eLoupes](#) - [Seattle, WA 98104](#)

eLoupes is a Seattle startup developing a new system for real time capture and mediated reality interaction. We are enhancing human capabilities with cutting...

[Easily apply](#)

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D3- Sr. NLP Deep Learning Data Scientist

[Allstate](#) - [5,269 reviews](#) - [Bothell, WA 98011](#)

543 new

[asl interpreter - Bellevue, WA](#)

[interpreter - Bellevue, WA](#)

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Distance:

<input type="submit" name="r_up" id="r_up" value="Go">

- Salary Estimate
- Job Type
- Location
- Company
- Experience Level

Experience developing natural language processing/understanding, machine learning, or artificial intelligence algorithms/models required....

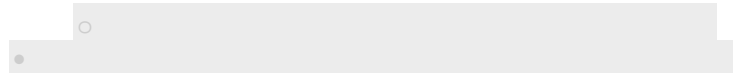
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Software Engineer for AI

[Microsoft](#) - [4,531 reviews](#) - Bellevue, WA

The AI for Office Communication Intelligence team is responsible for powering Outlook experiences and Cortana digital assistants....

2 days ago - [save job](#) - [more...](#)

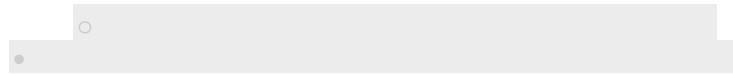


Character AI Engineer

[Microsoft](#) - [4,531 reviews](#) - Redmond, WA 98052

Extensive understanding of AI driven gameplay and AI systems. 2+ years of professional AI programming experience or similar....

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Research Software Engineer, Alexa AI

[Amazon.com](#) - [25,074 reviews](#) - Seattle, WA

Come build Artificial Intelligence! Alexa is the groundbreaking, cloud-based intelligent agent that powers the Echo and other devices designed around your voice...

2 days ago - [save job](#) - [more...](#)



Software Engineer - Artificial intelligence

[Posh Technologies](#) - [9 reviews](#) - Redmond, WA

Software Engineer Location: Redmond, WA Duration: 6-12 Months Responsibilities Designing and implementing end to end pipelines for collecting user...

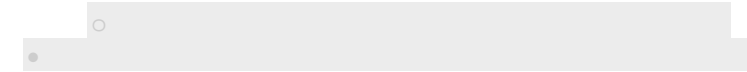
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Software Engineer, New Graduate 2018

Quantcast - 12 reviews - Seattle, WA

Quantcast is hiring software engineers to join our engineering teams in our Seattle office. As the real-time pulse of the Internet, Quantcast runs the world...

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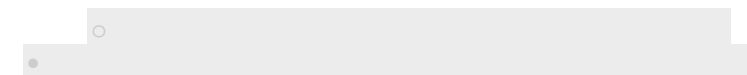


Software Engineer - new

Microsoft - 4,531 reviews - Bellevue, WA +4 locations

The Web Data team at Microsoft is looking for machine learning engineers who enjoy working on complex problems that push the boundaries of AI....

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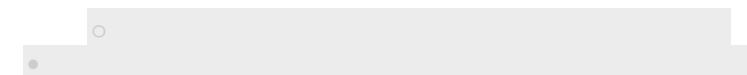


Software Development Engineer- Alexa AI- Seattle

Amazon.com - 25,074 reviews - Seattle, WA

Job Description The Alexa deep learning platform team is hiring! The team is building a distributed, GPU-accelerated deep learning stack for speech...

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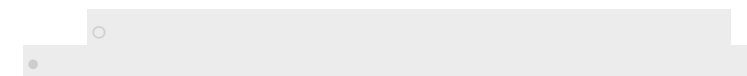


Data and Applications PM

Microsoft - 4,531 reviews - Redmond, WA 98052

Join the excitement of Artificial Intelligence in the Cloud at Microsoft! Be ready to think deeply, work hard, and have fun solving tough problems at the center...

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SDE AWS SageMaker Algorithms; Machine Learning; AI

Amazon.com - 25,074 reviews - Seattle, WA

Job Description Be a part of the rapid growth of AWS SageMaker! Since it launch in Nov 2017, AWS ML platform SageMaker has seen unprecedented customer adoption...

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Business Operations Associate

Microsoft - 4,531 reviews - Redmond, WA 98052

Sales intelligence and persuasion skills:. You've got the social intelligence and sales skills to understand (or explain) what needs to be changed, and why....

3 days ago - [save job](#) - [more...](#)

Lead Machine Learning Engineer

DISNEY - 3,954 reviews - Seattle, WA

"It takes people to make the dream a reality." Walt was onto something when he said that, and it continues to ring true today. Walt Disney Attraction...

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Technical Architect - Data & Artificial Intelligence

Vybrant - Bellevue, WA

Artificial Intelligence/Machine Learning/Data Science:. Managing technical product development strategy, delivering proof of concepts and pilots in the field of...

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Technical Architect - Data & Artificial Intelligence

Vybrant - Bellevue, WA

Artificial Intelligence/Machine Learning/Data Science:. Managing technical product development strategy, delivering proof of concepts and pilots in the field of...

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5 new

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65 new

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embedded software engineer - Bellevue, WA -

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- Salary Estimate
- Job Type
- Location
- Company
- Experience Level

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Associate, Advanced Analytics Modeler

KPMG - 4,419 reviews - Seattle, WA 98127

Lighthouse — KPMG's Center of Excellence for Advanced Analytics — has both applied data science, AI, and big data architecture capabilities....

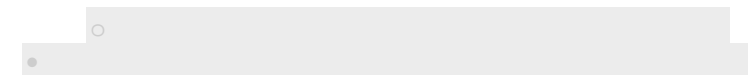
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Business Planner - Artificial Intelligence

Microsoft - 4,531 reviews - Redmond, WA 98052

These products are critical for our vision of bringing AI to every Enterprise. Defining and delivering the business model decisions for any new or updated AI...

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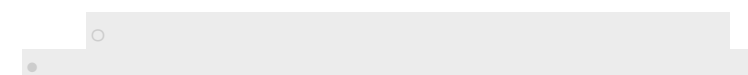


Systems Development Engineer - Alexa AI-Seattle

Amazon.com - 25,074 reviews - Seattle, WA

Job Description Alexa Machine Learning Platform team is hiring! We are building a secure, massively parallel, distributed machine learning platform to...

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Machine Learning Engineer

Dropbox - 21 reviews - Seattle, WA

Help shape the direction of machine learning and artificial intelligence at Dropbox. 5+ years of experience building machine learning or AI systems....

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Business Analytics Specialist

Microsoft - 4,531 reviews - Redmond, WA 98052

Microsoft Professional Program in AI. Within Microsoft Business Operations, the Global Shared Services (GSS) business intelligence (BI) team is based in Dublin,...

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Software Development Engineer - AWS Artificial Intelligence

Amazon.com - 25,074 reviews - Seattle, WA

Come and be part of the Amazon AWS Artificial Intelligence team! We are a cloud AWS service that helps customers run machine learning algorithms on various Big...

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AI Developer

Microsoft - 4,531 reviews - Redmond, WA 98052

Join the excitement of Artificial Intelligence in the cloud at Microsoft! We are part of a fast-paced AI team in the Cloud AI group, and our goal is to enable...

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Business Planner - AI & Insights

Microsoft - 4,531 reviews - Redmond, WA 98052

Driving market intelligence analyses to formulate strategic vision and business case. You will focus on a new set of innovative AI driven business solutions...

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Software Engineer - Machine Learning Platform

Apple - 5,610 reviews - Seattle, WA

Our group develops the platform that Apple uses for developing machine learning, artificial intelligence, and computer vision applications....

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Data Engineer, Alexa AI

Amazon.com - 25,074 reviews - Seattle, WA

Experience gathering business requirements, using industry standard business intelligence tool(s) to extract data, formulate metrics and build reports....

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SDE-Machine Learning

Posh Technologies - 9 reviews - Redmond, WA

Someone who is/was a Data scientist and has deployed AI based web services to the cloud. Software Development Engineer – Machine Learning....

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AI Solution Architect - Seattle and Redmond, WA

Avanade - 188 reviews - Seattle, WA

You consider yourself an expert in the AI field, and are looking to help Avanade grow its AI presence at clients....

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Machine Learning AI - Bellevue, WA - Locals Only

Tech Observer - 13 reviews - Bellevue, WA

Architect, design, and optimize Cloud AI platform frameworks. 2+ year experience in AI frameworks or Cloud platforms....

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Cognitive/Robotics Automation Architect

IBM - 21,902 reviews - United States

Creating end-to-end automation solutions utilizing all of IBM's capabilities in Cognitive/Watson, Artificial Intelligence, Machine Learning and Robotic Process...

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-

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Distance:

- Salary Estimate**
- Job Type**
- Location**
- Company**
- Experience Level**

You consider yourself an expert in the AI field, and are looking to help Avanade grow its AI presence at clients....

Sponsored - [save job](#)

Machine Learning AI - Bellevue, WA - Locals Only

Tech Observer - 13 reviews - Bellevue, WA

Architect, design, and optimize Cloud AI platform frameworks. 2+ year experience in AI frameworks or Cloud platforms....

[Easily apply](#)

Sponsored - [save job](#)

Technical Architect - Data & Artificial Intelligence

Vybrant - Bellevue, WA

Artificial Intelligence/Machine Learning/Data Science:. Managing technical product development strategy, delivering proof of concepts and pilots in the field of...

[Easily apply](#)

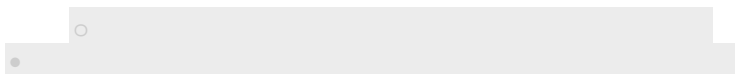
Sponsored - [Visited](#) 15 hours ago [save job](#)

AI Lead – Workplace Analytics Customer Solutions

Microsoft - 4,531 reviews - Redmond, WA 98052

With over 100 million mailboxes and the fastest growing cloud service in the industry, Office 365 represents the world’s largest store of human behavioral and...

30+ days ago - [save job](#) - [more...](#)

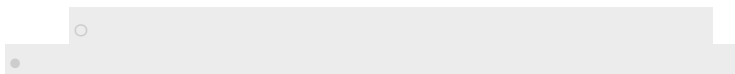


AIMS – AI/Machine Learning Manager

BOEING - 5,461 reviews - Bellevue, WA

The Boeing Company is looking for a talented results driven Artificial Intelligence (AI) & Machine Learning Manager (ML) to lead a team of highly talented data...

3 days ago - [save job](#) - [more...](#)



Program Manager

Microsoft - 4,531 reviews - Redmond, WA 98052 [+2 locations](#)

The Distribution Services Platform (DSP) team in the Cloud + AI team builds and runs the digital distribution service which sits at the heart of most of...

7 days ago - [save job](#) - [more...](#)



Associate, Advanced Analytics Modeler

KPMG - 4,419 reviews - Seattle, WA 98104 (First Hill area)

Lighthouse — KPMG's Center of Excellence for Advanced Analytics — has both applied data science, AI, and big data architecture capabilities...

KPMG LLP - 30+ days ago - [save job](#) - [more...](#)



Manager, Software Development- Alexa AI- Seattle

Amazon.com - 25,076 reviews - Seattle, WA

Job Description Amazon's Echo device and the related Alexa persona are both revolutionary and game changing innovations in driving voice first interactions...

18 days ago - [save job](#) - [more...](#)



Data Scientist - new

Amazon.com - 25,076 reviews - Seattle, WA

Are you interested in driving the development of methods, models and systems for state-of-the-art optimization, robotics, and fulfillment systems?...

15 hours ago - [save job](#) - [more...](#)



Software Development Engineer I

Amazon.com - 25,076 reviews - Bellevue, WA +1 location

We are a smart team of doers that work passionately to apply cutting-edge advances in robotics and software to solve real-world challenges that will transform...

30+ days ago - [save job](#) - [more...](#)



Software Development Engineer (Core AI team)

Amazon.com - 25,076 reviews - Seattle, WA

We are looking for a Software Development Engineer in the Core AI team to help us building an internal hosted notebook service....

30+ days ago - [save job](#) - [more...](#)



WOS Software Development Engineer

Intel - 3,459 reviews - Seattle, WA 98101 (Downtown area)

Job Description We are looking for passionate and energetic software engineer who has a very good understanding & can enable and optimize Machine Learning...

30+ days ago - [save job](#) - [more...](#)



Technical Program Manager, Artificial Intelligence/ML Infras...

Facebook - 348 reviews - Seattle, WA

Knowledge of Machine Learning / Artificial Intelligence. Do you have a background in running Artificial Intelligence/Machine Learning (AML) at scale to improve...

30+ days ago - [save job](#) - [more...](#)



Software Engineer (Computer Vision, Robotics)

Proprio - Seattle, WA 98104

Our team has a deep background in neurosurgery, medical devices, entrepreneurship, robotics, and computer vision, and is working closely with leading medical...

[Easily apply](#)

Sponsored - [save job](#)

Lead Machine Learning Engineer

DISNEY - 3,954 reviews - Seattle, WA

"It takes people to make the dream a reality." Walt was onto something when he said that, and it continues to ring true today. Walt Disney Attraction...

Sponsored - [save job](#)

Cognitive/Robotics Automation Architect

IBM - 21,904 reviews - United States

Creating end-to-end automation solutions utilizing all of IBM's capabilities in Cognitive/Watson, Artificial Intelligence, Machine Learning and Robotic Process...

Appendix C

Employer Survey

Bellevue College (BC) is committed to providing high quality academic offerings that prepare skilled employees to meet the needs of business and industry. In addition to certificates and associate's degrees, the college offers Bachelor of Applied Science (BAS). These degrees combine baccalaureate-level theoretical knowledge and strong applied/technical skills.

BC is considering offering a new BAS degree in Robotics and Artificial Intelligence (ROBAI). This new BAS degree would prepare graduates to work in the growing field of robotics and artificial intelligence (AI) software development. The program would provide students with the knowledge and skills to design, implement, and analyze machine learning and embedded systems that power robotics and AI applications. This program would complete the last two years of the bachelor's degree. Graduates of associate degrees in an information technology - software development field could apply for admittance to this degree program.

The purpose of this survey is to determine demand for such a degree program in western Washington. All responses will be confidential and reported as an aggregate only. If you choose to provide contact information, it will be kept separate from survey responses and used solely for the purpose collected (letter of support, focus group, curriculum review or other development assistance).

We would appreciate your responses to the following questions.

25-49 Respondents

1. Industry projections tell us that the demand for software development professionals in the area of robotics and AI is growing. Do you agree?

- | | | |
|---------------------|-----------|----------------------------------|
| • Strongly agree | 22/44.90% | |
| • Agree | 16/32.65% | Total S/A & A: 77.55% |
| • Disagree | 0/0% | |
| • Strongly disagree | 0/0% | |
| • Don't know | 11/22.45% | |

49 Responses

Comments:

- I have a niece and nephew that love this class on robotics at their high school

2. Over the next 5 years, when hiring software development professionals in the area of robotics and artificial intelligence, what level of education do you anticipate requiring? We will primarily hire: (Please, select one)

- | | |
|--|-----------|
| • Mainly associate (2-year) degree graduates | 3/6.82% |
| • About the same number of bachelor degree and associate (2-year) degree graduates | 11/25% |
| • Significantly more bachelor degree than associate (2-year) degree graduates | 14/31.82% |
| • Bachelor degree graduates exclusively | 14/31.82% |
| • Master's degree and above graduates exclusively | 2/4.55% |

44 Responses

3. Please tell us why you prefer to hire Tech graduates with a bachelor's degree. If that's not the case, indicate why.

- Higher education standards.
- College graduates are more flexible, able to grow with organizations long-term into management, etc.
- More well-rounded education. (2)
- Students with bachelor's degrees tend to have more critical thinking skills and professionalism.
- More knowledge.
- Maturity.
- I think all education examples are worthwhile.
- Need some college, and then work experience.
- As opposed to an associate's degree, having at least a four-year degree helps to ensure a standard level of education among all working in such a complex field.
- Company policy. (2)
- I believe this level of education is required to perform the job.
- *Maybe, because I don't know why you would need a master's degree in tech.*
- Tech graduates can specialize, and don't necessarily require a four-year degree. However, more education would be required to advance significantly in the field. Unless, you are a genius.
- At least a bachelor's degree for a high tech field should be required.
- Better able to express ideas in writing and meetings; more rounded experience; better able to determine users' needs/wants.
- More schooling and experience.

36 responses (edited and refined for clarity)

4. When hiring software development professionals in the area of robotics and artificial intelligence, what job title are they listed under?

- Engineering (Robotics) (3)
- Don't know (22)
- Unknown
- Robotics/AI
- Development Technicians
- RAI Development (2)
- Software Developer (ROBAI) (5)

36 responses (edited and refined for clarity)

5. Please review and offer comments on the proposed ROBAI BAS (see attached)

- Pretty solid
- I recommend the research paper class requirement be a bit later in the program
- Glad to see course in dealing with contemporary moral problems.
- More programming (*this person didn't understand enough about programming, as there are 8 courses in programming in the degree*)
- I think this is a great set of courses and provides what's needed
- Yes
- Looks good (courses) (2)
- Maybe more statistics
- Make sure ethics is covered
- Include internship
- Kudos for a solid, focused approach

25 responses

6. What is the size of your organization in terms of number of employees?

- 1-9 4/16%
- 10-25 5/20%
- 26-50 1/4%
- 51-99 1/4%
- 100-499 1/4%
- 500 or more 13/52%

25 Responses

7. Please, identify the primary category for your organization.

- Advertising
- Aerospace 1/4%
- Banking
- Government 1/4%
- Healthcare 2/8%
- Hospitality (hotels, restaurants...)
- Manufacturing 2/8%
- Marketing
- Nonprofit 4/16%
- Recruiting agency
- Retail 3/12%
- Technology industry 3/12%
- Utilities
- Other (please specify) 9/36%

8. What is your primary role in your organization?

- Technology Professional 3/12%
- Hiring Manager 1/4%
- Senior Manager 3/12%
- Executive Officer 7/28%
- Other (please specify) 11/44%

9. Please, provide any additional comments.

- Interesting survey (2)
- This is a needed addition to our state

Appendix D
Skills Panel-Focus Groups
Robotics and Artificial Intelligence

Skills Panel-Focus Group 1

(Emphasis on development of AA degree in Robotics and Artificial Intelligence)

December 2016

Facilitator:

Terryll Bailey, The Allison Group

Panelists:

Michael Catalan - Project Manager, Pacific Northwest National Laboratory

Mark Greaves, Ph.D. -Technical Director of Analytics, Pacific Northwest National Laboratory

Steve McIrvine, MBA - CEO, Autel Robotics

Dave Nilosek, Ph.D. – Senior Software Engineer Manager, EagleView Technologies

Dima Protchenko, BS – Software & Data Analytics Engineer, Healthentic

Jean Scholtz, Ph.D. – Chief Scientist, Pacific Northwest National Laboratory

Mike Woogerd, President & Founder – Mobile Tools M Robotics

Skills Panel-Focus Group 2

(Emphasis on development of BAS degree in Robotics and Artificial Intelligence)

March 2018

Facilitator:

Maureen Majury, MA – Director, SBCTC Center of Excellence for Information and Computer Technologies

Panelists:

Dylan W. — Software Engineer

Hussain, M. – Senior Software Developer, Tyler Tech

Lydia D. – Dynamics NAV Support and Developer, Silverware, Inc.

Justin M. – Staff Infrastructure Engineer, Versive

Dennis K.—Software Engineer, Microsoft

Ryan O. – Systems Administrator, Coldstream Wealth Management

Trevor C. – Developer, Hax Geo

Wei L. – Systems Development Engineer II, Amazon

Nick A. – Software Developer. Slalom Consulting

Matt C. – Software Engineer, Mercedes-Benz Research & Development

STUDENT NAME		SID #	
PROGRAM CHAIR		DATE	

PROGRAM REQUIREMENTS			Requested Substitution/Transfer Credits (if applicable)			Completed		
Course	Course Title	CR	College/University	Course	CR	Grade	Quarter	Year
CORE COURSEWORK								
BUSIT 103	SQL Fundamentals	5						
DBA 130	Database Theory	5						
ENGR& 114	Engineering Graphics	4						
IT 103	Networking Basics	5						
IT 128	Information Security Essentials	5						
PROG 110	Introduction to Programming	5						
PROG 120	Object Oriented Programming Concepts	5						
PROG 160	Systems Analysis and Design	5						
PROG 260	Advanced Topics in Object Oriented Programming	5						
ROBAI 101	Intro to Robotics and Artificial Intelligence	5						
ROBAI 240	Programming for Machine Learning	5						
ROBAI 250	Embedded Systems and 3D Printing	5						
ROBAI 260	Additive Design and Manufacturing	5						
COMMUNICATION								
<i>Choose 10 credits from the following:</i>		10						
ENGL& 101	English Composition I (5 Cr)							
ENGL 201	The Research Paper (5 Cr)							
ENGL& 235	Technical Writing (5 Cr)							
HUMANITIES								
<i>Choose 5 credits from the following:</i>		5						
CMST 134	Cultural Studies in Mass Media (5 Cr)							
CMST 250	Communication in a Diverse Workplace (5 Cr)							
PHIL 102	Contemporary Moral Problems (5 Cr)							
QUANTITATIVE								
<i>Choose 5 credits from the following:</i>		5						
MATH 130	Introduction to Statistics (5 Cr)							
MATH 138	College Algebra for Business & Social Science (5 Cr)							
MATH& 141	Pre-Calculus I (5 Cr)							
NATURAL SCIENCE								
BIOL& 100	Survey of Biology (6 Cr)	6						
<i>One of the courses selected must fulfill Cultural Diversity Requirement of Bellevue College</i>								
GRAND TOTAL		90						

This degree will prepare graduates to work in the field of robotics and artificial intelligence application development. The program will provide students with the knowledge and skills to design, implement, and analyze basic machine learning and embedded systems that run robotics and AI applications. The program also introduces students to the science of computer vision and the fundamentals of robotics control systems. Lastly, students will learn to use 3D printing to develop and test prototypes.

LEARNING OUTCOMES

- Communicate effectively in the three areas of listening, writing and speaking
- Apply critical thinking and logical research to solve technological problems
- Apply basic statistical methods, and time series analysis and forecasting to solve robotics and artificial intelligence programming problems.
- Apply the basics of Python programming language to solve analytical, statistical problems related to machine learning

- Model, design, and analyze embedded system hardware and software architectures and communication protocols
- Design, develop and test control systems for robotics applications based on machine vision
- Apply 3D printing techniques to build models and prototypes

FOR MOST UP-TO-DATE INFORMATION, GO TO:

www.bellevuecollege.edu/programs/degrees/proftech/robai

Appendix F

PROPOSED BELLEVUE COLLEGE BACHELOR OF APPLIED SCIENCE ROBOTICS & ARTIFICIAL INTELLIGENCE (ROBAI)
 QUARTERLY/YEARLY DRAFT SCHEDULE

First Year			
Fall	Winter	Spring	Summer
ENGL& 101: Introduction to English (5 Credits) WRITTEN COMM	MATH 138: College Algebra for Business and Social Science (5 Credits) QUANTITATIVE	ENGR& 114: Engineering Graphics (4 Credits)	
BUSIT 103: SQL Fundamentals (5 Credits)	ROBAI 101: An Introduction to Robotics and Artificial Intelligence (AI) (5 Credits) (prereq: PROG 110)	DBA 130: Database Theory (prereq: BUSIT 103) (5 Credits)	
PROG 110: An Introduction to Programming (with Python) (5 Credits)	PROG 120: Object Oriented Programming Concepts (5 Credits)	CMST 250: Organizational Communications (5 Credits) OR PHIL 102: Contemporary Moral Problems (5 Credits) HUMANITIES/CULTURAL DIVERSITY REQ	
Second Year			
Fall	Winter	Spring	Summer
IT 103: Networking Basics (5 Credits)	BIO 100: Introduction to Biology (5 Credits) NATURAL SCIENCE	PSYC& 100: General Psychology (5 Credits) OR PSYC 203: Cognitive Psychology (5 Credits) SOCIAL SCIENCE	
PROG 260: Data Structures and Algorithms (5 Credits) (prereq: PROG 120)	ROBAI 240: Programming for Machine Learning (with Python) (5 Credits) (prereq: PROG 260)	ROBAI 260: Computer Vision in Control Systems (5 Credits) (prereqs: ENGR& 114 & PROG 260)	
ENGL 235: Technical Writing (5 Credits) (prereq: ENGL& 101) WRITTEN COMM	ROBAI 250: Additive Design and Manufacturing (5 Credits) (prereqs:	PROG 160: Systems Analysis and Design (5 Credits)	

	ENGR& 114 & PROG 260)		
Third Year			
Fall	Winter	Spring	Summer
BA 240: Statistical Analysis <i>(prereq: MATH 138)</i> (5 Credits) NATURAL SCIENCE	DRMA 210: Scene Technology (4 Credits) AND DRMA 290: Technical Practice (1 Credit) <i>(Take both classes concurrently total of 5 credits/Includes welding/soldering)</i> HUMANITIES	CMST 340: Applied Organizational Communication (5 Credits) <i>(recommended: CMST& 220, 230 or 280)</i> HUMANITIES	
ROBAI 370: Advanced Computer Vision/Sensors (5 Credits) <i>(prereq: ROBAI 260: Computer Vision, Robotics and Control Systems)</i>	BUS&: 101 Introduction to Business (5 Credits) SOCIAL SCIENCE	ROBAI 380: Architectural Robots & Mechatronic Design (5 Credits) <i>(prereqs: IT 103, ROBAI 4XX: Computer Vision, ROBAI 4XX: Advanced AI, ROBAI 250: Embedded Systems & 3D Printing)</i>	
ISIT 330: Business Intelligence Applications (5 Credits) <i>(prereq: BUSIT 103 or ISIT 331)</i>	ISIT 337: Predictive Analytics (5 Credits) <i>(prereq: ISIT 330)</i>	BUS 230: Project Management (5 Credits)	
Fourth Year			
Fall	Winter	Spring	Summer
MATH 341: Applied Statistical Methods I (5 Credits) <i>(prereq: BA 240)</i>	ROBAI 405: Advanced AI & Applications for Machine Learning (5 Credits) <i>(prereq: ROBAI 240: Programming for Machine Learning (with Python)</i>	PHIL 375: Ethical Issues in Information Technology (5 Credits) SOCIAL SCIENCE	
ROBAI 401: Language and Speech Technology (5 Credits) <i>(prereqs: IT 103, ROBAI 370: Advanced Computer Vision, ROBIA 250: Additive Design and Manufacturing, 3D Printing, DRAMA 210 & 290)</i>	ROBAI 410: Autonomous Systems (5 Credits) <i>(prereqs: IT 103, ROBAI 370: Advanced Computer Vision, ROBIA 250: Additive Design and Manufacturing, 3D Printing, DRAMA 210 & 290)</i>	ROBAI 415: Capstone I (Internship and Prototyping Project) (5 Credits) <i>(Permission of ROBAI Program Chair)</i>	
PHYS 109: Science of Information Technology (5 Credits) NATURAL SCIENCE	ISIT 324: Software Testing (5 Credits)	ISIT 328: Information Security Essentials (5 Credits)	

Appendix G

Respondents byCC

Q2 COLLEGE	
Grand Total	94
Bellevue College	29
Seattle Colleges (all camp..	26
Green River College	17
Highline College	11
Lake Washington Institut..	6
Cascadia College	5

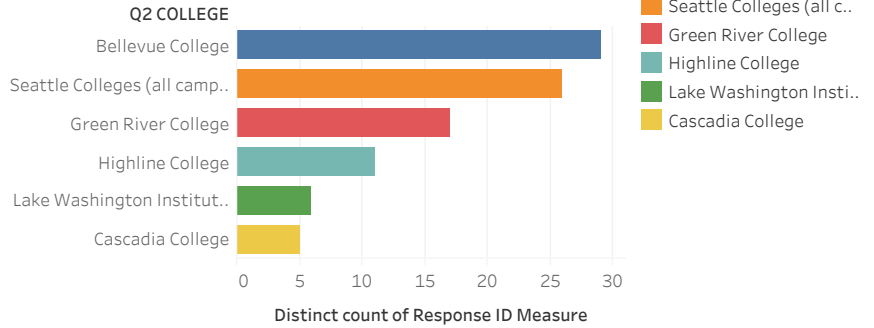
Overall interest

Question Description (Descr..	Textual Answer (An..	% of Total Distinct co..	Distinct count of R..
If Bellevue College offered a bachelor's degree in Robotics and Artificial...	Yes	42%	37
	Maybe	39%	34
	No	19%	17

FT/PT

Question Description (Description]	Textual Answer (An..	% of Total Di..	Distinct count o..
If you did choose to enroll in the ROBAI degree program at Bellevue College...	Full-time	55%	46
	Part-time	31%	26
	Not sure	14%	12

Respondents byCC Graph



Interest byCC

Question D..	Q2 COLLEGE	Textual Ans..	% of Total Di..	Distinct cou..
If Bellevue College offered a bachelor's degree in Robotics and Artificial...	Bellevue College	Yes	48%	14
		Maybe	41%	12
		No	10%	3
	Seattle Colleges (all campuses)	Yes	32%	7
		Maybe	41%	9
		No	27%	6
Green River College	Yes	59%	10	
	Maybe	24%	4	
	No	18%	3	
Highline College	Yes	27%	3	
	Maybe	45%	5	
	No	27%	3	
Lake Washington Institute of ..	Yes	60%	3	
	Maybe	40%	2	

College Set

- Bellevue College
- Cascadia College
- Green River College
- Highline College
- Lake Washington Insti..
- Seattle Colleges (all ca..

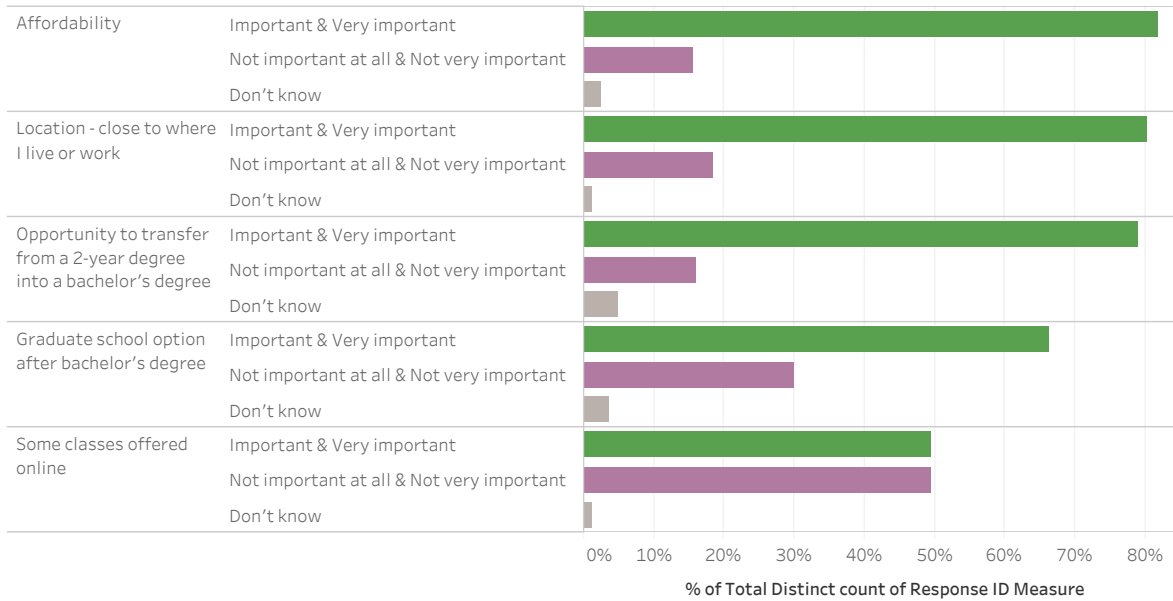
Importance

Question Description (Description)]	Very important	Important	Not very importa..	Not important at ..	Don't know
Affordability	51%	31%	12%	4%	2%
Location - close to where I live or work	32%	48%	16%	2%	1%
Opportunity to transfer from a 2-year degree into a bachelor's degree	54%	25%	10%	6%	5%
Graduate school option after bachelor's degree	39%	28%	24%	6%	4%
Some classes offered online	27%	22%	31%	19%	1%

College Set

- Bellevue College
- Cascadia College
- Green River College
- Highline College
- Lake Washington Insti..
- Seattle Colleges (all ca..

Importance graph



Textual Answer (Answer) ..

- Important & Very imp..
- Not important at all & ..
- Don't know

Importance byCC

Q2 COLLEGE	Question Description (Des..	Very important	Important	Not very importa..	Not important at..	Don't know
Bellevue College	Affordability	59%	15%	11%	7%	7%
	Location - close to where I live or work	35%	42%	15%	8%	
	Opportunity to transfer from a 2-year degree into a bachelor's degree	31%	38%	12%	12%	8%
	Graduate school option after bachelor's degree	41%	26%	22%	7%	4%
	Some classes offered online	36%	32%	16%	16%	
Seattle Colleges (all campuses)	Affordability	60%	30%	10%		
	Location - close to where I live or work	32%	47%	16%		5%
	Opportunity to transfer from a 2-year degree into a bachelor's degree	75%	20%	5%		
	Graduate school option after bachelor's degree	37%	42%	11%	5%	5%
	Some classes offered online	45%	10%	35%	10%	
Green River College	Affordability	31%	44%	19%	6%	
	Location - close to where I live or work	44%	31%	25%		
	Opportunity to transfer from a 2-year degree into a	63%	19%	13%	6%	

College Set

- Bellevue College
- Cascadia College
- Green River College
- Highline College
- Lake Washington Insti..
- Seattle Colleges (all ca..

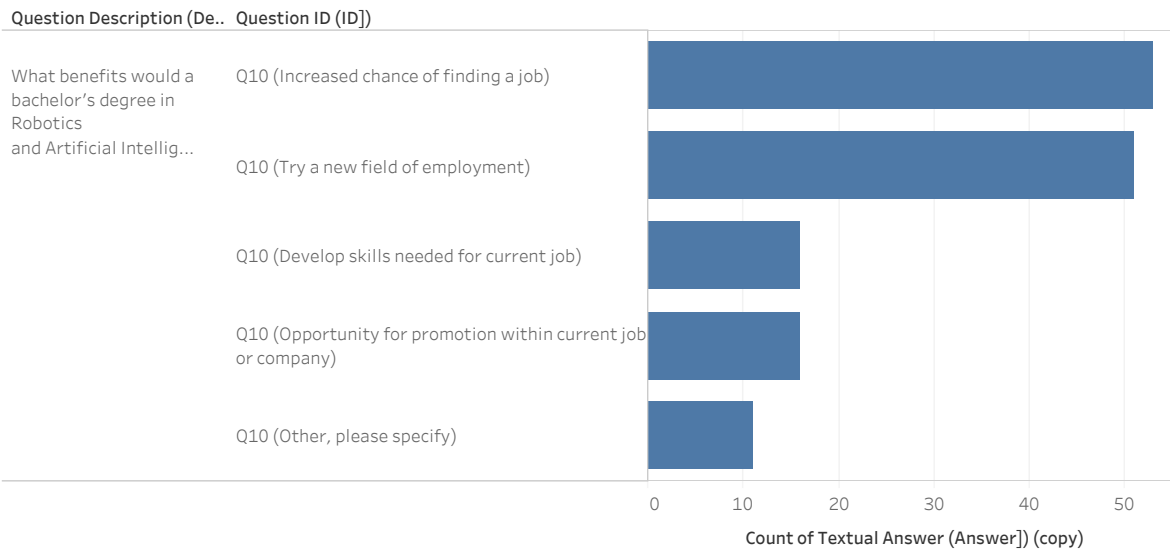
Benefits

College Set

- Bellevue College
- Cascadia College
- Green River College
- Highline College
- Lake Washington Insti..
- Seattle Colleges (all ca..

Question Description (Description])	Question ID (ID])	
What benefits would a bachelor's degree in Robotics and Artificial Intellig...	Q10 (Increased chance of finding a job)	53
	Q10 (Try a new field of employment)	51
	Q10 (Develop skills needed for current job)	16
	Q10 (Opportunity for promotion within current job or company)	16
	Q10 (Other, please specify)	11

Benefits graph



Appendix H

From: Mason Norman [<mailto:mnorman@sbctc.edu>]
Sent: Monday, November 13, 2017 7:42 PM
To: Iulia Zavodov <iulia.zavodov@bellevuecollege.edu>
Subject: RE: New Program: Approval Requested

Hi Iulia,

Thank you. The Robotics and Artificial Intelligence AAS-T is approved and have been added to Bellevue's inventory.

If I can be of any further assistance, please do not hesitate to contact me.

Respectfully,

Mason Norman | *Education Program Coordinator*
Washington State Board for Community & Technical Colleges
1300 Quince St SE, Olympia, WA 98504
p: 360-704-4337
mnorman@sbctc.edu

College Programs: Bellevue

Primary	Option	EPC	Plan Code	Program Title	Capacity	Compl	Credit	Clock	Award
---------	--------	-----	-----------	---------------	----------	-------	--------	-------	-------

Primary/Option

11.0201		515		Information Systems	60	65	90-91		AAS-T
	11.0201	515		Intermediate Applications Developer			30		C
	11.0201	515		Introductory C++ Programming			20		C
	11.0201	515		Introductory.NET Programming			45		C
	11.0201	515		Programming for Mobile & Web Development	15	15	45		C
	11.0802	503		Database Analyst	30	15	25		C
	11.0802	503		Database Report Developer	30	15	45		C
	15.0405	640		Robotics and Artificial Intelligence			90		AAS-T
11.0801		524		Advanced Video Production	18	10	48		C
11.0802		503		Business Intelligence Analyst			30		C
11.0802		503		Intermediate Business Intelligence Analyst	12	6	30		C
11.0802		503		Intermediate Business Intelligence Developer	12	6	30		C
11.0803		504		Digital Media Arts	24	8	90		AA
11.0901		527		Cisco Support Technician	26	0	46		C
11.0901		527		Microsoft Network Support	26	0	45		C
11.0901		527		Network Services and Computing Systems			90-93		AAS-T
	11.0901	527		Cloud Architecture & Services	26	15	46		C
11.1006		509		Application & Desktop Support Specialist			45		C
11.1006		509		Operating Systems Support Specialist			45		C
11.1006		509		Technical Assistant	40	25	24-26		C
13.1210		402		Early Childhood Education	75	8	90		AA
13.1210		46E		State Early Childhood Education Certificate			47-52		C
	13.1210	40E		State Initial Early Childhood Education Certificate			12		C
	13.1210	41E		State Short Early Childhood Education Certificate – General			20		C
	13.1210	42E		State Short Early Childhood Education Certificate – Infant Toddler Care			20		C
16.9998		438		Interpretation	70	12	24		C
16.9998		438		Translation			24		C

Primary	Option	EPC	Plan Code	Program Title	Capacity	Compl	Credit	Clock	Award
41.0101		678		Molecular Sciences Technician	50	25	91		AAS-T
43.0103		832		Criminal Justice			90-91		AAS-T
50.0408		734		Interior Studies	56	40	95		AA
51.0000		328		Associate of Applied Science-Transfer Allied Health	50	15	90		AAS-T
	51.0703	532		Health Unit Coordinator	20	20	63-72		C
	51.0711	310		Clinical Laboratory Assistant	36	24	50-59		C
	51.0712	312		Medical Administrative Assistant	42	21	48-57		C
	51.0714	315		Medical Billing and Coding			63-72		C
	51.0801	381		Medical Assistant			83-92		C
	51.1009	382		Phlebotomy Technician	66	30	43-52		C
	51.1501	437		Alcohol & Drug Counseling	40	30	50		C
	51.9998	391		Emergency Department Technician	30	24	52-61		C
51.0706		521		Healthcare Informatics	10	8	49		C
51.0903		333		Neurodiagnostic Technology	12	12	105		AA
51.0905		357		Nuclear Medicine Technology	18	8	95		AA
51.0905		357		Positron Emission Tomography	3	3	26		C
51.0907		354		Radiologic Technology	80	22	104		AA
51.0910		393		Diagnostic Ultrasound Technology	40	51	111-112		AA
51.0911		358		CT Imaging	10	5	32		C
51.0911		358		Magnetic Resonance Imaging	10	7	32		C
51.0911		358		Vascular Interventional Program	6	3	30		C
51.0989		355		Medical Dosimetry	10	8	83		C
51.0989		355		Radiologist Assistant	10	5	89		C
51.0993		353		Radiation Therapy	16	16	120		AA
51.2706		408		Healthcare Data Analytics	12	9	44		C
51.3801		323		Nursing - AAS-T	95	55	116-117		AAS-T
51.3801		RND		Nursing DTA / MRP			135-140		ADN
52.0201		502		Business Management	200	25	90		AA
	52.0701	254		Entrepreneurship			30		C
52.0201		502		Project Management	30	25	25		C
52.0204		547		Business Technology	45	15	90-93		AA
	10.0303	743		Desktop Publishing for Print & Web	20	12	40		C
	11.0601	518		Advanced Business Technology Specialist			46-48		C

Primary	Option	EPC	Plan Code	Program Title	Capacity	Compl	Credit	Clock	Award
	11.0601	518		Business Technology Specialist	50	25	30-31		C
	11.0601	518		Database User Specialist	30	15	25		C
	11.0801	524		Web Content Management	30	15	41		C
	52.0204	547		Administrative Assistant	60	45	51		C
	52.0204	547		Web Marketing Specialist	8	15	54-56		C
	52.0408	559		Integrated Office Assistant for ESL	25	25	42		C
	52.0408	559		Office Assistant			24-27		C
	52.1001	545		Human Resources Assistant	30	12	48		C
52.0302		505		Accounting AA	50	45	92-94		AA
	52.0302	505		Accounting Assistant			46-49		C
	52.0302	505		Accounting Information Systems			30		C
	52.0302	505		Bookkeeping			29		C
	52.0302	505		Financial Data Report Specialist	30	20	30		C
52.1401		245		Marketing Management	75	7	90		AA
	52.1401	245		Digital Marketing			97		AAS-T
	52.1402	244		Promotional Marketing	30	8	45		C
	52.1803	251		Retail Marketing			45		C
	52.1803	252		Sales			30		C
98.0003		887		Occupational & Life Skills	55	15	90		AOLS

Short-term Programs

11.0901		527		Cloud Technologies			10		C
11.0901		527		Mobile Technologies			10		C
31.0301		169		Wilderness Skills			19		C
31.0504		351		Yoga Instructor			15		C
31.0505		346		Personal Fitness Trainer			19		C
51.0910		393		Breast Ultrasound			8-11		C
51.0911		358		Imaging Aide			19		C
51.3902		329		Nursing Assistant – Certified for ESL			9		C
51.3902		329		Nursing Assistant - Certified			12		C
52.0302		505		Accounting Preparation			16		C

Short-term Non-credit Programs

11.0201		515		ADA Developer Academy Certificate (non-credit)				400	C
11.0201		515		C# Programming Certificate (non-credit)				172	C
11.0201		515		Software Test & Development Engineer (non-credit)				112	C
11.0201		515		Software Test Engineer (non-credit)				194-237	C
11.0802		503		Database Administrator Certificate (non-credit)				190	C
11.0802		503		Database Business Intelligence Developer (non-credit)				204	C
11.0802		503		Database Developer Certificate (non-credit)				220	C
11.1004		515		Front End Web Developer Certificate (non-credit)				172	C
11.1004		515		User Experience (UX) Design Certificate (non-credit)				192	C
11.1004		515		Web Design Certificate (non-credit)				166.5	C
11.1006		509		Desktop Support Certificate (non-credit)				164	C
11.1006		509		Network Support Certificate (non-credit)				151	C
23.1303		510		Technical Writing Certificate (non-credit)				110	C
50.0409		731		Graphic Design Cert (non-credit)				190.5-210	C
51.0708		574		Medical Transcription (non-credit)	30	20		484	C
51.0714		315		Medical Billing and Coding (non-credit)				80	C
51.2706		439		Healthcare Data Analyst (non-credit)				227	C
51.3801		323		RN Refresher Program (non-credit)				101	C
52.0201		502		Project Management (non-credit)				153	C
52.1001		545		Human Resources Management (non-credit)				123	C

AAS-T Degree Programs

13.1210		402		Early Childhood Education				93-94	AAS-T
52.0201		502		Business Management				90	AAS-T
52.0302		505		Accounting AAS-T				94-99	AAS-T

Baccalaureate Degree Programs

11.0301	51B			Bachelor of Applied Science-Information Systems & Technology					BAS
11.0701	CSB			Bachelor of Science Computer Science			180		BAS
11.0802	50D			Bachelor of Applied Science - Data Analytics					BAS
26.0210	98B			Bachelor of Applied Science-Molecular Biosciences (Fall 2016)					BAS
50.0408	73B			Bachelor of Applied Arts-Interior Design					BAA
51.0001	3BA			Health Promotion and Management			180		BAS
51.0701	34B			Healthcare Management and Leadership			180		BAS
51.0706	52B			Bachelor of Applied Science - Health Care Informatics					BAS
51.0989	355			Bachelor of Applied Science-Radiation & Imaging Sciences			180		BAS
51.3801	32B			Bachelor of Science-Nursing					BSN
52.0302	5AA			Bachelor of Applied Science-Applied Accounting (Fall 2015)					BAS
52.1401	24D			Bachelor of Applied Science- Digital Marketing			180		BAS

Primary	Option	EPC	Plan Code	Program Title	Capacity	Compl	Credit	Clock	Award
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Inactive Programs

Primary	Options	EPC	Plan Code	Program Title	Capacity	Credit	Award
10.0201		740		Movie Making (7/10/2017)	35	91	AA
		515		C# Web Development Certificate (non-credit) (11/10/2019)			C
11.0201		515		Information Systems (7/8/2016)			
	11.0801	524		Digital Video Production (6/1/2016)			
11.0802		503		Business Intelligence Developer (3/24/2019)	30	45	C
	11.0802	503		Database Administration Assistant (7/7/2019)		40	C
	11.0803	504		Animation & Graphics (7/1/2016)			
	11.0803	504		Digital Gaming (7/1/2016)			
11.0901		524		Network Services & Computing Systems (3/24/2019)	52	91-94	AA
		515		Web Development Certificate (non-credit) (11/10/2019)			C
13.1210		402		Early Childhood Education (7/1/2016)			
	13.1210	402		Infant & Toddler Care (6/1/2016)			
	43.0202	829		Fire Officer (7/10/2017)		20	C
	43.0203	828		Fire Science (7/10/2017)	100	45	C
43.0203		828		Fire Science (7/10/2017)	200	90	AA
	51.9998	391		Emergency Department Technician Professional (7/10/2017)		20	C
		502		Business Management Certificate (non-credit) (11/10/2019)			C
	52.0201	502		Sustainability Coordinator (7/10/2017)	35	49	C
	52.0201	502		Sustainable Business Accounting (7/10/2017)	35	30	C
52.0201		502		Sustainable Business Practices (7/10/2017)	35	90-94	AA
	52.0201	502		Sustainable Systems Best Practices (7/10/2017)	35	30	C
52.0302		505		Financial Information Systems Specialist (7/1/2016)			
	98.0003	887		Occupational & Life Skills (3/22/2020)		45	C

Appendix I



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Redmond, WA 98052-3981
425 558 4224
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March 28, 2018

Dr. Tracy Biga MacLean
Associate Director, Effectiveness and Strategic Planning
Bellevue College
3000 Landerholm Circle SE
Bellevue, WA 98007-6484

Dear Associate Director MacLean:

This is in reply to electronic correspondence received in our office on January 25, 2018, requesting approval from the Northwest Commission on Colleges and Universities (NWCCU) for Bellevue College to add an Associate of Applied Science-Transfer degree program in Robotics and Artificial Intelligence to its education offerings, effective fall 2018. The Associate of Applied Science-Transfer degree program in Robotics and Artificial Intelligence requires 90 quarter credits to completion and fewer than 50% of the program requirements will be delivered using a distance education instructional modality. The College Curriculum Advisory Council reviewed and approved the addition of the new degree program on October 2017. The Washington State Board of Community and Technical Colleges authorized the College to add the new degree program on November 13, 2017. After using one-time external grant funds for the purchase of specialized equipment and curriculum development in the implementation phase, Bellevue College has existing resources and capacity to offer the Associate of Applied Science-Transfer degree program in Robotics and Artificial Intelligence.

The Commission has approved the abovementioned change as a *minor change* under Commission Policy, *Substantive Change*. Accordingly, the addition of the Associate of Applied Science-Transfer degree program in Robotics and Artificial Intelligence with fewer than 50% of the program requirements to be delivered using a distance education instructional modality is now included under the accreditation of Bellevue College.

Thank you for keeping the Northwest Commission on Colleges and Universities apprised of developments and initiatives at Bellevue College. If you have questions, please do not hesitate to contact me.

Sincerely,

Valerie W. Martinez
Vice President

c: Dr. Jerry Weber, President
Dr. Marlene Moore, President, NWCCU

Appendix J

Applied Baccalaureate Degree Supply/Demand Gap Data based on SBCTC Rubric

Bellevue College: BAS Degree in Robotics and Artificial Intelligence

College Name: Bellevue College	
Program Name: BAS degree in Robotics and Artificial Intelligence	
Select one: Existing Occupation <input type="checkbox"/> or Emerging Occupation <input checked="" type="checkbox"/>	
If local demand/supply information is available for the specified degree program and target occupation(s),**	
For demand: Provide local/regional demand data for the targeted occupation job title(s) from traditional labor market data, industry data, trade association data, or other transactional data. <i>(Provide absolute numbers, not just percentages)</i>	Please see table below
For supply gap: Provide data on the number of programs and the number of annual program graduates for all four-year colleges that supply your region. Is the number of current annual graduates insufficient to meet current and projected demand? (The result of demand minus supply).	Please see table below

Degree Completions in fields related to robotics and AI versus Annual Job openings						
Year	Bachelor Degree Completions	Master Degree Completions	Ph.D Degree Completions	Total Completions	Annual Job Openings (screened for robotics and AI)	Gap
2017	28	28	0	56	7,910	7,854
2016	26	19	0	45	6,203	6,158
2015	23	27	0	50	8,160	8,110
2014	32	0	0	32	6,524	6,492
TOTALS	109	74	0	183	28,797	28,614

Table I

Analysis:

Table I above shows degree completions in robotics technology/technician, mechatronics, robotics and automation and AI related programs for 2014, 2015, 2016 and 2017. It also shows annual job openings, screened for robotics and AI for these same years. This data was compiled by Economic Modeling Specialist International (EMSI), which extracted the degree completions from the Integrated Post-Secondary Education Data System published by the Department of Education’s National Center for Education. The table shows only four years of data because no school in King County had degree completions in these specialized fields prior to 2014, a clear indication of the novelty of these fields. 2017 represents the last year of available degree completion data.

According to the EMSI data, the University of Washington (UW) is the only school to offer programs related to robotics and AI. The total number of degrees produced over this four year period were 183. Of these completions, 109 were Bachelor degrees and 74 were Master’s degrees. The 109 bachelor degrees were earned in Mechanical Engineering with an option in mechatronics. The 74 master’s degrees were granted from Computer Science Engineering program with concentrations in AI. The EMSI data also estimated the total number of job openings for positions in these fields to be 6,524, 8,160, 6,203 and 7,910 in 2014, 2015, 2016 and 2017 respectively. There exists, then, a sizeable gap between job demand and degree production. Employer demand clearly exceeds the regional supply of graduates with relevant degrees

However, because BC used a broad range of SOC’s in making its labor market case (see statement of need, pp 8-18), we supplement the aforementioned program completion-employer demand gap data with a more expansive review of academic programs and job openings. (See table II below) This adds, in our view, a greater dose of objectivity and will account for the likely possibility that a portion of robotics and AI jobs

will be filled by IT professionals other than robotics and AI specialists. In doing so, BC offers a more instructive account of program completion-employer gap data.

To its original program list, BC added four new disciplines that might supply graduates for robotics and AI jobs. The program search, as reconstituted, included robotics technology, mechatronics, robotics and automation, artificial intelligence, computer science, computer software engineering, computer systems analysis/analyst, application computer programming, and computer and information sciences. This eight program search revealed 10 institutions in King County that produced 589, 651, 687 and 778 degree completions for 14,071, 16,453, 15,907 and 14,048 openings in 2014, 2015, 2016, and 2017 respectively. This data demonstrates a sizeable gap between the number of graduates produced and annual job openings. More important, even if one uses only the annual job openings specific to robotics and AI (6,524 for 2014, 8,160 for 2015, 6,203 for 2016 and 7,910 for 2017)—one still observes that employer demand exceeds the regional supply of graduates by a considerable amount. This gap is compounded even further when one accounts for the fact that of this larger pool of degree completions—taking 2017 as an example—208 were Master’s degrees, 18 were Ph.Ds. and 25 were post-baccalaureate certificates. Bachelor degree completions comprised only 520 of the total completions in 2017. Since the annual job openings figures were based on bachelor degree qualifications, we believe this indicates that there is opportunity and capacity for increased production of bachelor degrees in robotics and AI.¹

Expanded Degree Completions for 10 regional institutions versus annual job opening – general and specific to robotic and AI								
Year	Bachelor Degree Completions	Postbaccalaureate certificate	Master Degree Completions	Ph.D Degree Completions	Total Completions	Annual Job Openings	Annual Job Openings (screened for robotics and AI)	Gap*
2017	520	25	208	18	778	14,048	7,910	7,390
2016	461	14	196	16	687	15,907	6,203	5,742
2015	422	12	192	25	651	16,453	8,160	7,738
2014	416	0	155	18	589	14,071	6,524	6,108
TOTALS	1,819	51	751	77	2,705	60,479	28,797	26,978

Table II

*Annual Job openings screened for robotics and AI minus bachelor degree completions.

¹ See example EMSI report below for 2017 ; EMSI updated their data sets this past week which explains why these numbers are slightly different than those recently submitted in the body of Statement of Need.

Bellevue College

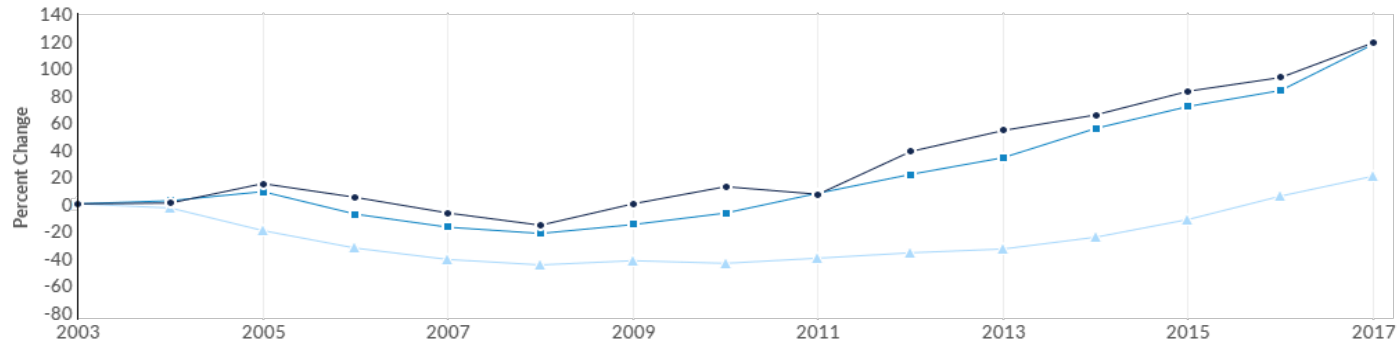
3000 Landerholm Circle
Bellevue, Washington 98077
4255641000

Program Overview

10 Regional Institutions had Completions in the last 15 years	778 Regional Program Completions (2017)	14,048 Annual Openings (2017)
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* Program Summary for 8 Programs - Settings

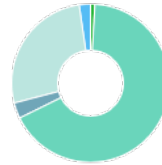
Regional Trends



Region	2003 Completions	2017 Completions	% Change
● Region	356	778	118.5%
● State	780	1,696	117.4%
● Nation	77,882	93,746	20.4%

* Regional Trends: Program - Settings

Regional Completions by Award Level



Award Level	Completions (2017)	Percent
Award of less than 1 academic year	7	0.9%
Bachelor's Degree	520	66.8%
Postbaccalaureate certificate	25	3.2%
Master's Degree	208	26.7%
Doctor's Degree	18	2.3%
Award of at least 1 but less than 2 academic years	0	0.0%
Associate's Degree	0	0.0%
Award of at least 2 but less than 4 academic years	0	0.0%
Post-masters certificate	0	0.0%

* Regional Completions by Award Level - Settings

Regional Completions by Institution

Institution	Certificates (2017)	Degrees (2017)	Total Completions (2017)
University of Washington-Seattle Campus	0	387	387
University of Washington-Bothell Campus	0	175	175
DigiPen Institute of Technology	0	95	95
Seattle University	25	60	85
Seattle Pacific University	0	16	16
City University of Seattle	0	13	13
South Seattle College	7	0	7
University of Phoenix-Washington	0	0	0
DeVry University-Washington	0	0	0
DeVry University-Washington	0	0	0

** Regional Completions by Institution - Settings*

Because the University of Washington, Tacoma is in Pierce County, it was not included in this table. BC wished to note that the UW, Tacoma's Institute of Technology offers five degrees. They are:

- Computer Science and Systems (TCSS)
- Computer Engineering and Systems (TCES)
- Cybersecurity and Leadership (T CSL)
- Electrical Engineering (TEE)
- Information Technology and Systems (T INFO)
- Institute of Technology (T INST)

None of these degree programs offers a degree or concentration in Robotics and AI. The Computer Science and Systems program offers three courses in these fields at the 400 and and 500 levels. They are:

- TCSS 437 Mobile Robotics (5)
- TCSS 455 Introduction to Machine Learning (5)
- TCSS 555 Machine Learning (5)



August 13, 2018

Dr. Joyce Hammer
Director, Transfer Education
SBCTC
PO Box 42495
Olympia, WA 98054-2495

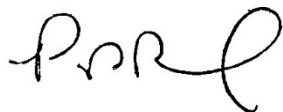
Dear Dr. Hammer,

Several units responded to our request for comments on Bellevue College's Notice of Proposal for a BAS in Robotics and AI. There doesn't seem to be a potential conflict, or any significant overlap or impact on our degree programs which address this area. They did provide comments for the SBCTC to consider as they review the proposal for further development. The comments we received are below.

- Anind Dey, Director of Undergraduate Program, Information School, recommends revising "the ethics class, as the syllabus doesn't touch on the ethics of AI and algorithm bias, which have become increasingly important topics."
- Matt Saxton, Associate Dean for Academics, Information School, says concerning potential overlap that, "There is a small amount with the Bachelor of Science Informatics degree with regard to curriculum in machine learning, information security, systems analysis, and databases. Overall, I observe the proposed ROBAI degree to be more specialized and narrower in scope than the Informatics degree".
- Saxton also states, "If an undergraduate student at BC transferred to UW, the programming courses, English, and Psychology courses taken in the first and second years would serve them well, but they would still need to fulfill a number of prerequisites before they could apply to the Informatics degree program. BC graduates with a ROBAI degree would be competitive candidates for the graduate program offered by the Information School."
- Dan Grossman, Associate Director, the Allen School, comments, "At the highest level, we have no objection and see no conflict. We have much respect for Bellevue College and their technology-related programs. They have been the leading source of transfer students to our undergraduate programs. There is certainly some overlap with our expertise and degree offerings. We are among the nation's leaders in both robotics and AI with multiple courses offered regularly on these topics. But that is not a problem."

We appreciate the effort that faculty for the colleges put into developing the proposals and are aware of how much effort it takes to shepherd them through an internal approval process. As these comments are meant to inform the development of the proposal as well as supportive, we do not think a response to them is necessary.

Sincerely,

A handwritten signature in black ink, appearing to read "PJR", with a stylized flourish at the end.

Philip J. Reid
Vice Provost, Academic and Student Affairs
Professor of Chemistry