BULLET BACKGROUND PAPER

ON

PROJECT ANNIE: ARTIFICIAL NEURAL NETWORKS AS A USAF TALENT-MANAGEMENT FORCE-MULTIPLIER

PURPOSE

Propose a method by which the USAF can leverage technological advances in artificial intelligence (AI) and machine learning (ML) to create Project ANNie (ANNie for short), an artificial neural-network (ANN) capable of making USAF recruiting and talent-management more effective, efficient, and innovative. Address benefits and costs of applying this ANN system to the pilot selection process as a proof-of-concept for applying ANN technology to USAF recruiting for all AFSCs

BACKGROUND

- Technological innovation, mainly within the private sector, has created astounding advances in AI/ML/ANN technology. These innovations continue to decrease costs and barriers to entry into these computational fields

- America's potential adversaries are investing heavily in AI/ML/ANN systems, threatening the possibility that the US may be outpaced in these technologies and lose its competitive advantage

- The USAF recruiting system has experienced strain in recent years, due to manning gaps in the recruiting force, significant territorial obligations for available recruiters, among many other factors

- Applications of AI/ML/ANN technology to talent-seeking, recruitment, and candidate screening has become common in the civilian sector, as have uses of these systems for personality analysis and other personnel decisions

  -- Companies like Ideal, Avrio AI Inc., and Entelo have developed talent-seeking AI applications. Others, including Emarsys and IBM Watson have developed application programming interface (API) platforms capable of drawing conclusions about individuals' personalities and skills by analyzing readily available data sets such as personal writing and social media posts. Still others, like Mitre, are already assisting the DoD on AI/ML efforts (such as Project Maven) and may be able to assist the USAF on other AI/ML applications as well

  --These companies demonstrate the significant improvements made possible by AI/ML/ANN technologies, including increased efficiency and reduced costs in comparison to traditional recruiting methods

- The pilot career field—our *raison d'être*—is currently in crisis due to high attrition rates. Finding ways to identify successful pilot candidates, particularly ones likely to remain in the USAF for extended periods of time, is imperative for the continuing success of the USAF as an organization

PROPOSAL

- The development of ANNie, an ANN system that can analyze data related to pilot candidates' potential performance, identify traits and intelligence/education/skill permutations indicating a stronger likelihood a candidate will successfully complete pilot training, and provide recommendations among available pilot candidates from the US Air Force Academy, ROTC programs, and Officer Training School recruitment pools

  --ANN Technology:

    --- An ANN is a "deep learning" network utilizing what is known a "feature hierarchy"—a system comprised of layers of nodes trained on a specific set of features based on the previous layer's output; these nodes

accumulate and recombine characteristics from the previous layer. This allows the network to handle very large, high-dimensional data sets with billions of parameters

--- This technology also utilizes "automatic feature extraction" and "clustering," allowing the ANN to process and cluster raw unlabeled and unstructured data, as well as distinguish between similarities and deviations in ways impossible for a human being

--- An ANN can "learn" from its input data, analyzing millions of potential calculations and variables, to output information concerning those inputs that might otherwise have been overlooked—or may have been impossible for a human being to analyze

--ANNie could utilize available data of pilot training graduates (GPA, Pilot Candidate Selection Method (PCSM) score, Fitness Assessment score, field training ranking, personality tests, social media, etc.) to ultimately determine which traits or combinations of traits are indicative of successful pilot candidates

--ANNie could classify and narrow the pools of available Air Force Academy, ROTC, and OTS candidates according to customizable sets of qualifications, with the ultimate goal of matching candidates with the identified traits to the pilot training program in order to identify the best possible candidates for pilot training

--ANNie could be further trained (and tested) by using backpropagation, an algorithmic method used to calculate the gradients and weights applicable to variables within the network, to check its outputs against the actual success rates of pilot candidates. For instance, feeding the ANN pilot candidate data for a previous year's pilot candidates, and determining whether the candidates selected by the ANN were, in fact, the pilot trainees who successfully completed training

--Further, ANNie could be used to identify traits and indicators of *unsuccessful* pilot candidates. This would provide an additional method of classifying potential candidates and eliminating those likely to be unsuccessful prior to beginning to invest in their training

- Potential Benefits:

--Implementability: The technology to implement Project ANNie, at least at a basic level, currently exists

--Friendlier, more effectual, teaming with the private sector. Given ethical concerns by civilian technology companies related to assisting the DoD in applying AI/ML/ANN technology to kinetic or operational uses, applying this technology to personnel matters will be more palatable to our potential private sector partners

--Reduced unconscious bias in pilot candidate selection. Focusing on objective traits and characteristics that make a person naturally excel at pilot training can limit or eliminate subconscious gender, racial, or economic biases in selection, especially when ANNie is paired with a human operator, who can further ensure diversity is obtained

--ANNie's analysis will complement the Pilot Training Next (PTN) initiative:

--- ANNie will provide a method for identifying pilot candidates more likely to be successful at the expedited and technology-heavy training PTN utilizes, which could allow for even greater reductions in training times, instructor manpower requirements, and more expensive aspects of training (i.e. sorties)

--- ANNie will be able to utilize PTN data—from simulator sorties, virtual reality training, etc.—as additional input data for its calculations and output, further enhancing its own ability to select successful candidates

--Creates a more effective and efficient USAF pilot candidate selection system: Innovates talent-management to target the *best* possible USAFA, OTS, and ROTC members for pilot training

--Significant possibilities for positive second-order and third-order effects, and expansion into other areas

--- Example: Broadening the scope of ANNie's inputs by forming data-sourcing partnerships at the national, state, and local levels (with organizations like the Federal Aviation Academy Youth Program, CyberPatriot, local high schools, etc.) in order to identify and target skilled potential USAF candidates at a younger age

--- Example: Use of ANNie's analytical power in conjunction with data from USAF's recently-developed, cloud-based Air Force Learning Services Ecosystem (AFLSE—a central repository for every Airman's learning record, including training, PME data, evaluations, etc.) to analyze learning styles, weaknesses, and strengths—potentially resulting in personalized training plans, recommendations for future positions, etc.

- Potential Challenges:

--Cost: Developing and executing Project ANNie could be expensive

--- Potential Solution: Partnering with private-sector companies already utilizing similar systems and tailoring a commercially available technology to develop a USAF-operated system

--Manpower: Development, maintenance, and continued customization of ANNie may require large numbers of programmers, IT support personnel, and others, along with associated costs in time and money for training

--Ethics/Public Perception: Acquisition and use of personal data by the USAF involves ethical and legal issues—including, potentially, legal constraints on domestic intelligence collection. Public perception, ala the outcry over the Cambridge Analytica scandal, must also be taken into account

--- Potential Solution: Data provided is an opt-in system (i.e. system isn't analyzing any data that wasn't freely provided by potential recruits or current USAF members)

--Security: AI/ML/ANN technologies present new and unique security concerns, including threats posed by untested code with the potential for vulnerabilities. These vulnerabilities could be used to force mistakes and/or false learning within the system over time

- Timeline: With available technology, creating a basic version of ANNie is possible within the next few years

- Possibilities for Expansion: Use of ANN technology can be expanded well beyond pilot candidate selection. Use of an ANN like ANNie could ultimately:

--Innovate talent-management to find and target the *best* possible USAF recruits: individuals who will best adapt as they make the transition from citizen to Airman; individuals who may succeed due to traits beyond merely academic requirements; individuals who are simply the best "fits" for their potential career tracks

--Revolutionize recruiting itself by automating key functions, reducing recruiter manpower requirements, minimizing recruiter tasks and time demands, and even assisting with the development of targeted (possibly even individualized) sales pitches for recruits—all while maximizing the identification of qualified recruits

--"Talent-source" by locating specific, qualified individuals best-suited to particular career fields and then tailoring recruiting efforts to target these individuals

--Find and reduce deficiencies/inefficiencies in recruitment efforts—both for the USAF as a whole and for particular career fields

CONCLUSION

The development of ANNie, an ANN designed to analyze a wide-range of data sets and offer recommendations, is an implementable use of currently-available technologies with the potential to drastically increase the efficiency and decrease the cost of the USAF's pilot candidate selection process. As ANN technology can be customized and expanded to analyze recruiting issues within other USAF AFSCs, development of ANNie would also be the USAF's first step toward leveraging these technologies on a grander scale

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