Opportunity Title: AI/ML Utilization of Genomic Data for Synthetic Biology Applications Fellowship
Opportunity Reference Code: ICPD-2024-35

Organization Office of the Director of National Intelligence (ODNI)

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How to Apply **Create and release your Profile on Zintellect** – Postdoctoral applicants must create an account and complete a profile in the on-line application system. **Please note: your resume/CV may not exceed 3 pages.**

Complete your application – Enter the rest of the information required for the IC Postdoc Program Research Opportunity. The application itself contains detailed instructions for each one of these components: availability, citizenship, transcripts, dissertation abstract, publication and presentation plan, and information about your Research Advisor co-applicant.

Additional information about the IC Postdoctoral Research Fellowship Program is available on the program website located at: https://orise.orau.gov/icpostdoc/index.html.

If you have questions, send an email to ICPostdoc@orau.org. Please include the reference code for this opportunity in your email.

Application Deadline 2/28/2024 6:00:00 PM Eastern Time Zone

Description **Research Topic Description, including Problem Statement:**

The increasing availability and volume of genetic data, technical knowledge and tools, and the advance of Artificial Intelligence (AI) / Machine Learning (ML) capabilities is revolutionizing science. AI/ML-powered synthetic biology stands to alter the biological threat and opportunity paradigm and raises unique challenges that need to be better understood.

The technology and data driving the global genomics industry is developing rapidly. A leading driver of genomic data volume is the Earth Bio Genome Project (EBP). The EBP aims to sequence, catalog and characterize the genomes of all of Earth's eukaryotic biodiversity. Together with advances in synthetic biology, automation and AI / ML this huge volume of genetic data will enable a multitude of beneficial applications for humankind (i.e. in medicine, conservation of biodiversity and understanding of life). Synthetic biology is an evolving and diffusing technology that will greatly benefit from genetic data resources such as what the EBP is producing. Genetic data resources in combination with AI / ML can be used to predict the effect of genetic changes made to an organism. Once the intended change is confirmed in silico, the genetic changes can be made in vivo far more rapidly using sophisticated synthetic biology tools than with previous methods. Synthetic biology has applications in health, agriculture, biosecurity and the environment and could help solve some of Australia's greatest challenges.

What are the possible applications stemming from AI / ML-powered synthetic biology? What are the risks and vulnerabilities of employing or not employing AI / ML-powered or supported synthetic biology? What do international research trends suggest are the major development or investment directions? How might potential concerns be mitigated?

Example Approaches:

Research proposals could approach this issue from a variety of disciplines, or as a cross-disciplinary effort. The challenge touches on aspects of synthetic biology, AI / ML, future applications, transnational issues, ethics and privacy. With respect to national security and intelligence interests, proposals could consider:

- Review scientific trends in genomic science and AI / ML science, with a view to examining joint implications over the medium to long term, and stress testing through modelling or experimentation of hypothetical scenarios.
- The medium to long term utility of AI / ML platforms to; enhance current or develop novel synthetic biology tools/techniques and/or generate novel tools/techniques for the detection of modified organisms.
- With respect to AI/ML development trends, evaluate the coordination among domestic and global stakeholders for monitoring, assessment and mitigation of risks associated with advances in synthetic biology research and applications.
- Evaluating the international societal effects and public policy implications, with respect to privacy and social license guardrails, of synthetic biology research and development.

Relevance to the Intelligence Community:

Genomic data is increasingly valuable to society (industry, governments and the environment). Genomic data science combined with AI/ML for use in synthetic biology applications raises unique national security, ethical and privacy challenges. These rapidly evolving concerns stand to be better understood. Potential challenges include:

- National security:
  - Changing an organism's natural function into a threat, such as toxic products or infectious agents.
  - Intentionally corrupting genomic data (e.g. altering sequences or annotations) in order to delay or skew research programs.
- Privacy and ethical:
  - Population surveillance, oppression and extortion of citizens, military, and intelligence personnel.
  - Discrimination or leverage against individuals based on disease risk, mental health and physical characteristics.
  - Public acceptance and social license relating to certain applications of synthetic biology.

References:

- Jun Cheng et al., (2023) 'Accurate proteome-wide missense variant effect prediction with AlphaMissense'. Science, DOI:10.1126/science.adg7492.
- https://www.earthbiogenome.org/
- https://www.csiro.au/en/work-with-us/services/consultancy-strategic-advice-services/csiro-futures/futureindustries/synthetic-biology-roadmap

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Key Words: Genomics, Synthetic Biology, Artificial Intelligence

Qualifications

Postdoc Eligibility

- U.S. citizens only
- Ph.D. in a relevant field must be completed before beginning the appointment and within five years of the appointment start date
- Proposal must be associated with an accredited U.S. university, college, or U.S. government laboratory
- Eligible candidates may only receive one award from the IC Postdoctoral Research Fellowship Program

Research Advisor Eligibility

- Must be an employee of an accredited U.S. university, college or U.S. government laboratory
- Are not required to be U.S. citizens

Eligibility Requirements

- **Citizenship:** U.S. Citizen Only
- **Degree:** Doctoral Degree.
- **Discipline(s):**
  - **Chemistry and Materials Sciences** (12)
  - **Communications and Graphics Design** (3)
  - **Computer, Information, and Data Sciences** (17)
  - **Earth and Geosciences** (21)
  - **Engineering** (27)
  - **Environmental and Marine Sciences** (14)
  - **Life Health and Medical Sciences** (45)
  - **Mathematics and Statistics** (11)
  - **Other Non-Science & Engineering** (2)
  - **Physics** (16)
  - **Science & Engineering-related** (1)
  - **Social and Behavioral Sciences** (30)