**Opportunity Title:** Interactive Topographic Map of Crime Syndicate Ancestry Fellowship

**Opportunity Reference Code:** ICPD-2024-25

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| **Organization** | Office of the Director of National Intelligence (ODNI) |
| **Reference Code** | ICPD-2024-25 |
| **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.

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| **Application Deadline** | 2/28/2024 6:00:00 PM Eastern Time Zone |
| **Description** | **Research Topic Description, including Problem Statement:** |

Digital or technology-related financial frauds and crypto-asset based crime are rapidly increasing, threatening the Australian community's financial security, national economic stability and our national security. With the advent of cryptocurrencies, digital assets, distributed ledger technologies and services, and digital payments, identifying the perpetrators and enablers of these crimes has become even more difficult.

Ancestry graphing is a tool that can used to build Interactive Topographical ancestry maps. This visual representation would enable to the financial Intelligence analysts to see the underlying contour maps depicting roots of crime types and related entities. To build this requires research in similarity search, height field computation, graph rendering, layout and interaction to establish ancestral graph models of related entities. An example of this approach relating to ancestry graphing can be done using Interactive Topographical ancestry maps is illustrated below. 1

Illustration Example: The chart comprises 426 person nodes and 161 family nodes, visualized with lifelines. Siblings are grouped in red family circles, while red curves indicate a person's lifespan. The underlying contour map represents a temporal height field, immediately showing ancestral roots (topside, dark blue) as well as persons who are still alive today, indicated by life lines reaching to white hill tops. The graph layout visually preserves its major ancestral structure, but also reveals topological features like circular connections. *email program for copy chart*

**Example Approaches:**

This proposal aims to adopt the following approaches:

- Unsupervised machine learning algorithms capable to classify unlabeled multidimensional data to facilitate detection of suspicious

transactions.

- Automated provenance reconstruction tool for forensic investigation.

This proposal plans to exploit the hidden connections among information flow, transaction logs, payment histories, and crime-families using unsupervised machine learning by assessing the clustering tendency of the collected datasets using a visual assessment of tendency family of algorithms. These algorithms reorder the pairwise dissimilarity matrix of the input data and then generate a reordered dissimilarity image or cluster heat map that shows possible clusters in the data.

The project would develop a novel investigative toolkit to facilitate attribution of criminals linked to digital payments to crime in near real-time. A vector database representation of payment transaction data and overlaying of open-source intelligence with crime data enable a rich source of interactive visual map for the relevant authorities to efficiently analyze and create models for crime-generative hot-spots, families, and siblings. The project aims to design and build a high-usability automated provenance reconstruction tool to facilitate forensic investigators for timely attribution of payments to crime over time using interactive topographical attribute mapping.

**Relevance to the Intelligence Community:**

The outcome of this project may benefit the challenges in anti-money laundering and counter terrorism financing mainly with the following:

- Clustering Module - to identify inter-cohort interactions based on unsupervised statistical learning clustering technique.
- 3D Topographic Map - to provide a topographic density vector map of syndicate history with interactive query facility.

## References:

- 1 Preiner, R., Schmidt, J., Krösl, K., Schreck, T., & Mistelbauer, G. (2020) 'Augmenting node-link diagrams with topographic attribute maps', Computer Graphics Forum, 39(3), 369–381. https://doi.org/10.1111/cgf.13987.
- Definitions of Vector Databases: https://learn.microsoft.com/en-us/semantic-kernel/memories/vector-db.
- Features of a Vector Database: https://mlops.community/empowering-language-model-applications-understanding-and-evaluating-vector-databases-in-production/.
- Vector Databases vs Vector L braries: https://lakefs.io/blog/12-vector-databases-2023/.
- Types of Databases: https://www.datacamp.com/blog/the-top-5-vector-databases.
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- Pros & Cons: https://www.linkedin.com/pulse/unleashing-power-vectors-embeddings-vector-databases-huaping-gu/.

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**Key Words:** Anomaly detection, Digital payments, Provenance reconstruction, data visualization.

## 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 👁)