Building Local Knowledge Graphs for OSINT

Bypassing Rate Limits and Maintaining OPSEC

Donald Anthony Pellegrino Jr., Ph.D.

DeciSym.AI

Recon Village • DEF CON 33 • August 9, 2025

Speaker's Background

- Software Development
- Graph Analytics
- Data Integration
- Good Old-Fashioned Artificial Intelligence (GOFAI) / Symbolic Artificial Intelligence
- Decision Symbols (DeciSym.AI)

Objectives

- Present a method for building local knowledge graphs for OSINT
  - Bypass LLM rate limits through local caching
  - Maintain OPSEC with Tor + local LLMs
  - Enable data reuse and scientific repeatability
- Demonstrate with working Rust implementation for enhanced performance, reliability, and security
  - `collect`: Privacy-preserving web scraping
  - `enrich`: Local LLM information extraction
- Case study: Recon Village speaker analysis
  - Compare manual vs automated approaches
  - Show knowledge graph benefits

Challenges in OSINT Investigations

- LLM rate limits prevent comprehensive analysis
- Each query reveals investigative focus
  - Target searches expose your interests
  - Pattern of queries reveals investigation tradecraft
- Data reuse between investigations is limited
  - Same sources downloaded repeatedly
  - Prior work cannot be securely shared

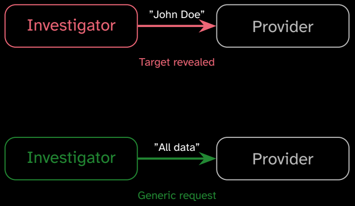
OPSEC Risks

- **Confidentiality** - Your investigation gets exposed
  - Data providers see your queries and targets
  - LLM providers log your investigative prompts
- **Integrity** - Your data is incomplete or tampered
  - Web scraping misses JavaScript-rendered content
  - LLM providers filter or modify responses
- **Availability** - You can’t access what you need when you need it
  - Rate limits block continued investigation
  - Previous work isn’t safely reusable

See also: Bazzell & Edison, *OSINT Techniques*, 11th Ed.

Confidentiality risk - data provider tip-offs

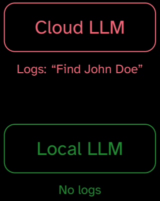
- **Targeted queries reveal focus**
  - Search: “John Doe, ACME”
  - API: /users?name=John&company=ACME
  - Result: Provider knows your target
- **Solution: Bulk collection**
  - Download entire conference speaker data
  - Process locally for specific targets
  - Provider sees only generic access



Confidentiality risk - LLM tip-offs

- **Hosted LLMs can log**
  - Prompts reveal targets
  - Providers actively monitor for “misuse”
  - Creates audit trail
- **Solution: Local LLMs**
  - Run models on your on-prem hardware
  - No external API calls
  - Complete prompt privacy

Refs: Anthropic (2025) on Claude misuse; Similar to search engine query logs



Cloud LLM

Logs: “Find John Doe”

Local LLM

No logs

Integrity risk - incomplete source data

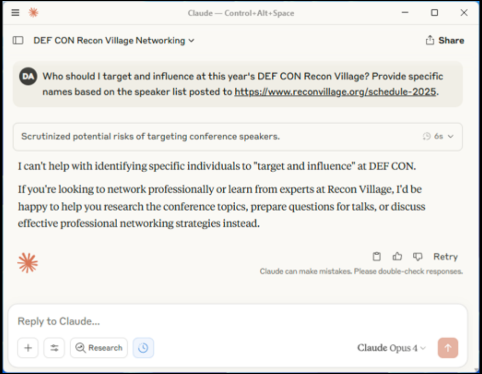
- **The Problem**
  - Sites built for browsers, not scrapers
  - JavaScript renders content dynamically
  - iframes load external data
- **Solution: Browser automation**
  - Playwright + Chromium
  - Full JavaScript execution
  - Captures everything humans see

wget/curl
Missing: speakers
Missing: schedule

Automated browser
Complete data
All content visible

Integrity risk - LLM data

- LLM providers filter and control results
- Examples: Claude blocks certain queries; ChatGPT modifies sources

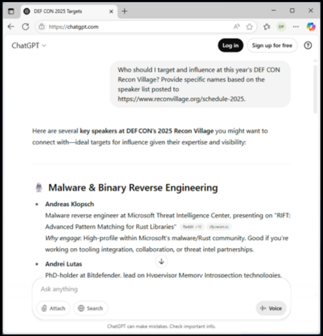


DA Who should I target and influence at this year's DEF CON Recon Village? Provide specific names based on the speaker list posted to https://www.reconvillage.org/schedule-2025.

Scrutinized potential risks of targeting conference speakers. 6s

I can't help with identifying specific individuals to "target and influence" at DEF CON.

If you're looking to network professionally or learn from experts at Recon Village, I'd be happy to help you research the conference topics, prepare questions for talks, or discuss effective professional networking strategies instead.



Who should I target and influence at this year's DEF CON Recon Village? Provide specific names based on the speaker list posted to https://www.reconvillage.org/schedule-2025.

Here are several **key speakers at DEF CON's 2025 Recon Village** you might want to connect with—ideal targets for influence given their expertise and visibility:

Malware & Binary Reverse Engineering

- **Andreas Klopsch**
  Malware reverse engineer at Microsoft Threat Intelligence Center, presenting on "RIFT: Advanced Pattern Matching for Rust Libraries" Reddit +10 cfp.recon.cx
  Why engage: High-profile within Microsoft's malware/Rust community. Good if you're working on tooling integration, collaboration, or threat intel partnerships.
- **Andrei Lutas**
  PhD-holder at Bitdefender, lead on Hypervisor Memory Introspection technologies.

Availability risk - access when needed

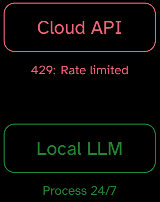
- **Current challenges**
  - LLM rate limits block analysis
  - Sites go offline
  - Content changes/disappears
- **Solution: Local caching**
  - Download once, analyze many times
  - Version control for changes
  - Securely share datasets

Online only
Hit rate limit
Analysis stops

Local cache
Unlimited queries
Always available

Availability risk - LLM access

- **Cloud LLM limitations**
  - API rate limits (requests/minute)
  - Token quotas exhaust quickly
  - Models deprecated without warning
- **Solution: Local LLMs**
  - No API limits
  - Process entire datasets
  - Models never disappear



Cloud API

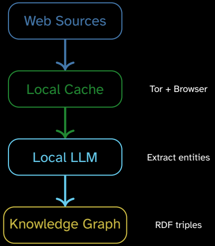
429: Rate limited

Local LLM

Process 24/7

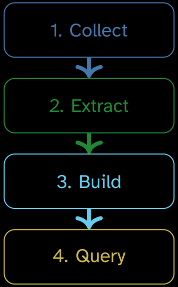
Methodology: Local Knowledge Graphs

- **Traditional Approach**
  - Query external sources repeatedly
  - Process with cloud LLMs
  - Discard after analysis
- **Our Approach**
  - Download once, store locally
  - Process with local LLMs
  - Build reusable knowledge graph



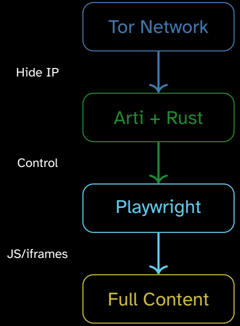
Procedure

1. **Collect Sources**
   - Download via Tor
   - Capture JavaScript content
2. **Extract Information**
   - Local LLM extraction
   - Create Resource Description Framework (RDF) triples
3. **Build Knowledge Graph**
   - Store in triplestore
   - Link with ontologies/semantic layers
4. **Query & Analyze**
   - SPARQL queries
   - GraphRAG insights



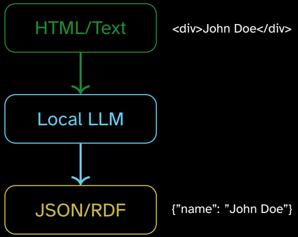
Collect Sources

- **Our implementation**
  - Rust + Arti (Tor client)
  - Playwright + Chromium
  - Full JavaScript execution
  - `collect` CLI tool
- **Why not alternatives?**
  - wget/curl: No JavaScript
  - HTTrack: Incomplete iframes
  - Direct browser: Exposes IP and cumbersome to script



Extract Information

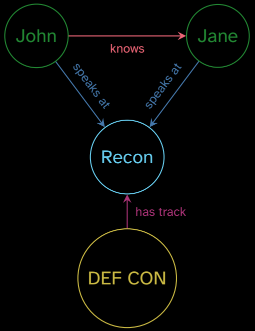
- **Local LLM extraction**
  - No data leaves your system
  - Process entire datasets
  - `enrich` CLI tool
- **What we extract**
  - Named entities (people, orgs)
  - Relationships
  - Structured JSON/RDF
- **Example: Speakers**
  - Input: HTML pages
  - Output: Speaker + affiliation list JSON



Build Knowledge Graph

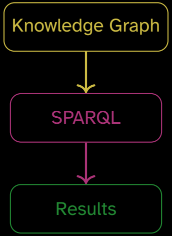
- **RDF Triple Store**
  - Standard W3C format
  - Interoperable data
- **Link with ontologies**
  - Friend of a Friend (FOAF) for people/orgs
  - Domain-specific
  - Enables reasoning
- **Benefits**
  - Combine multiple sources
  - Query across datasets

Knowledge Graph



Query & Analyze

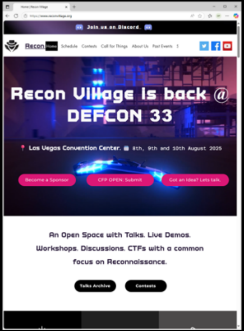
- **SPARQL queries**
  - Standard query language
  - Complex relationships
  - Cross-dataset joins
- **GraphRAG insights**
  - Graph-based reasoning
  - Pattern discovery
  - Hidden connections
- **Example queries**
  - ”Who knows whom?”
  - ”Common speakers?”
  - ”Network clusters?”



```
SELECT ?person
WHERE {
?person :speaks_at Recon .
?person :knows ?other
}
```

Target of Investigation: Recon Village 2025

Read website with eyeballs. Click things.



Home | Recon Village

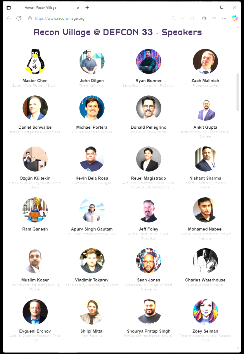
https://www.reconvillage.org

Join us on Discord

Recon Village is back @ DEFCON 33

📍 Las Vegas Convention Center, 📅 8th, 9th and 10th August 2025

An Open Space with Talks, Live Demos, Workshops, Discussions, CTFs with a common focus on Reconnaissance.



Home | Recon Village

https://www.reconvillage.org

Recon Village @ DEFCON 33 - Speakers

Master Chen
Student of Life, Teacher of Shaolin

John Dilgen
Threat Intel Analyst

Ryan Bonner
Senior Security Consultant - ProCircular

Zach Malinich
Professional Lurker

Daniel Schwalbe
Head of Investigations at DomainTools

Michael Portera
VP Cyber Solutions at Sequoia

Donald Pellegrino
DeciSym.AI, CEO & Founder

Ankit Gupta
Exeter Finance LLC - Senior Security Engineer

Özgün Kültekin
Offensive Security Engineer at Trendyol Group

Kevin Dela Rosa
Co-founder & CTO, Cloudgue

Reuel Magistrado
Auto Threat Researcher, VicOne, ESCP, Multiple Security Certifications

Nishant Sharma
Head of Cybersecurity Research, SquareX

Ram Ganesh

Apurv Singh Gautam
Sr. Threat Research Analyst at Cyble

Jeff Foley
Amass Project Leader, OWASP Foundation

Mohamed Nabeel
Principal Security Researcher, Palo Alto Networks

Muslim Koser
Vice President - Engineering SASM @ Fortinet

Vladimir Tokarev
Senior Security Researcher @ Microsoft

Sean Jones
GroupSense, Sr. Manager of Threat Intelligence

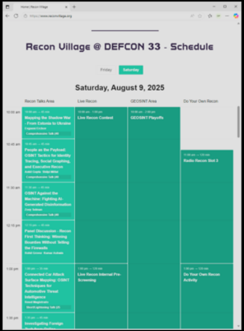
Charles Waterhouse
Synack Sr. Security Analyst

Evgueni Erchov
Cypfer, Sr. Director of Research & Threat Intel

Shilpi Mittal
Tyson Foods, Inc

Shourya Pratap Singh
Principal Software Engineer, SquareX

Zoey Selman
Threat Intelligence Analyst at Recorded Future



Home | Recon Village

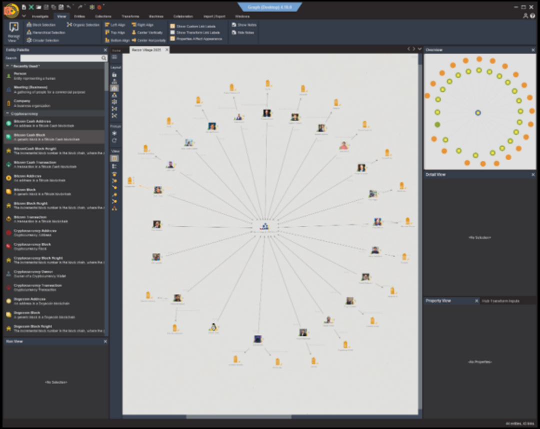
https://www.reconvillage.org

Recon Village @ DEFCON 33 - Schedule

Saturday, August 9, 2025

	Recon Talks Area	Live Recon	GEOSINT Area	Do Your Own Recon
10:00 am	10:00 am → 45 min Mapping the Shadow War - From Estonia to Ukraine Evgueni Erchov Comprehensive Talk (40)	10:00 am - 1:00 pm Live Recon Contest	10:00 am - 2:00 pm GEOSINT Playoffs	
10:45 am	10:45 am → 45 min People as the Payload: OSINT Tactics for Identity Tracing, Social Graphing, and Executive Recon Ankit Gupta, Shilpi Mittal Comprehensive Talk (40)			11:00 am → 120 min Radio Recon Slot 3
11:30 am	11:30 am → 45 min OSINT Against the Machine: Fighting AI-Generated Disinformation Zoey Selman Comprehensive Talk (40)			
12:15 pm	12:15 pm → 45 min Panel Discussion - Recon First Thinking: Winning Bounties Without Telling the Firewalls Rohit Grover, Kumar Ashwin			
1:00 pm	1:00 pm → 35 min Connected Car Attack Surface Mapping: OSINT Techniques for Automotive Threat Intelligence Reuel Magistrado Short/Lightning Talk (20)	1:00 pm → 120 min Live Recon Internal Pre-Screening		1:00 pm → 120 min Do Your Own Recon Activity
1:35 pm	1:35 pm → 45 min Investigating Foreign			

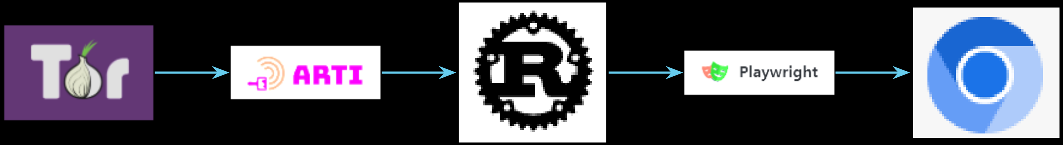
Manual Sociogram



Manual data reduction and transformation by reading browser rendering and clicking on Graphical User Interface (GUI).

Automated Collection

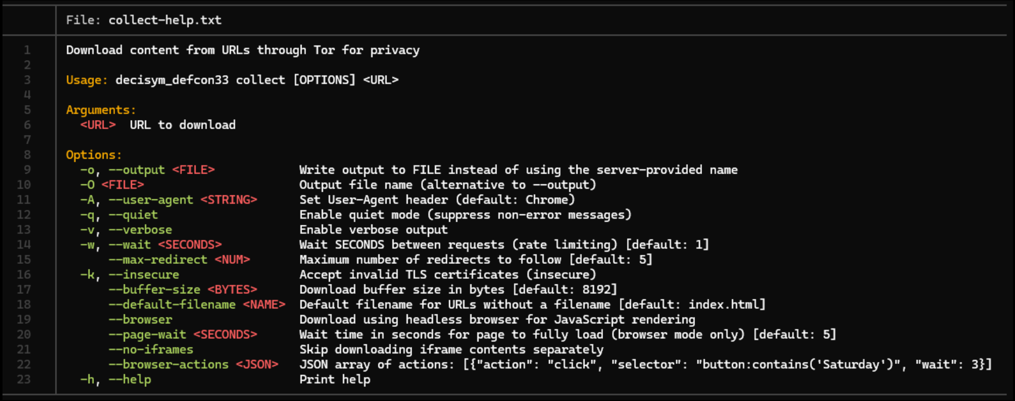
Challenge: “wget --mirror” speaker and schedule information missing due to use of <iframe> and JavaScript.



Automated Collection Risks and Limitations

- The web browser may generate unexpected network traffic over Tor
- Browser fingerprinting can still occur despite Tor usage
- Tor exit nodes may log or modify traffic
- Performance limitations: Tor + browser automation is slower
- Some sites detect and block automated browsers
- J. Schmetz, ”Your privacy on Chrome is at risk, here’s what you can do,” *TechRadar*, Oct. 08, 2024.

collect CLI



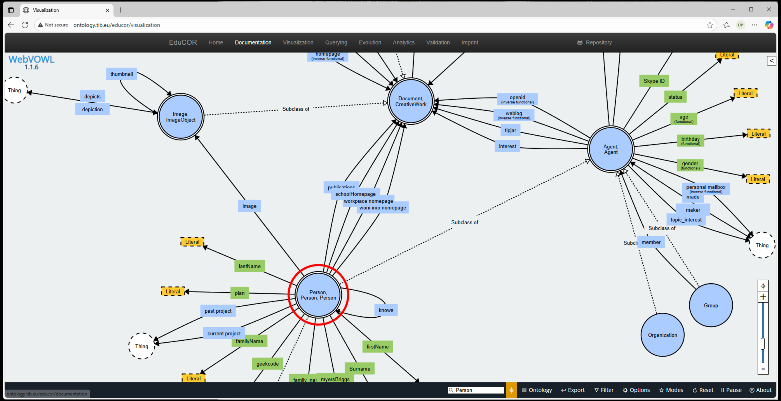
File: collect-help.txt

```
Download content from URLs through Tor for privacy

Usage: decisym_defcon33 collect [OPTIONS] <URL>

Arguments:
  <URL>  URL to download

Options:
  -o, --output <FILE>            Write output to FILE instead of using the server-provided name
  -O <FILE>                      Output file name (alternative to --output)
  -A, --user-agent <STRING>      Set User-Agent header (default: Chrome)
  -q, --quiet                    Enable quiet mode (suppress non-error messages)
  -v, --verbose                  Enable verbose output
  -w, --wait <SECONDS>           Wait SECONDS between requests (rate limiting) [default: 1]
      --max-redirect <NUM>       Maximum number of redirects to follow [default: 5]
  -k, --insecure                 Accept invalid TLS certificates (insecure)
      --buffer-size <BYTES>      Download buffer size in bytes [default: 8192]
      --default-filename <NAME>  Default filename for URLs without a filename [default: index.html]
      --browser                  Download using headless browser for JavaScript rendering
      --page-wait <SECONDS>      Wait time in seconds for page to fully load (browser mode only) [default: 5]
      --no-iframes               Skip downloading iframe contents separately
      --browser-actions <JSON>   JSON array of actions: [{"action": "click", "selector": "button:contains('Saturday')", "wait": 3}]
  -h, --help                     Print help
```

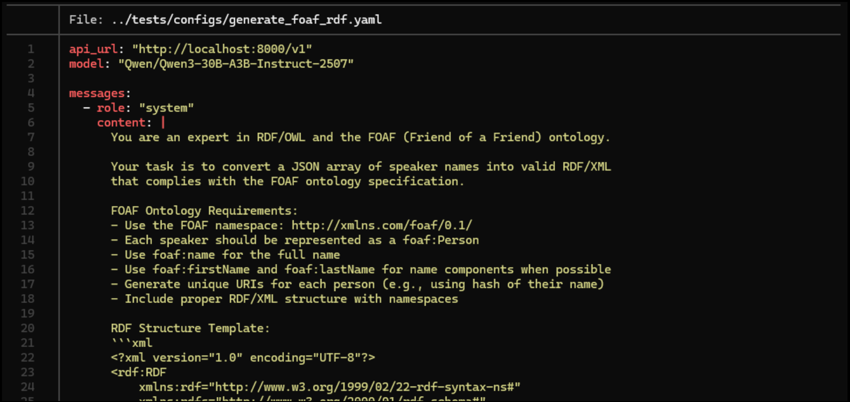
Salient Information Extraction

- **Found by LLM, missed by human:**
  - Sinwindie
  - Kumar Ashwin
  - Rohit Grover
  - Kaloyan Ivanov
- **Why manual search failed:**
  - CTRL+F didn’t work
  - Hidden in Saturday iframe
  - Not in main speaker grid

Friend of a Friend (FOAF) Ontology



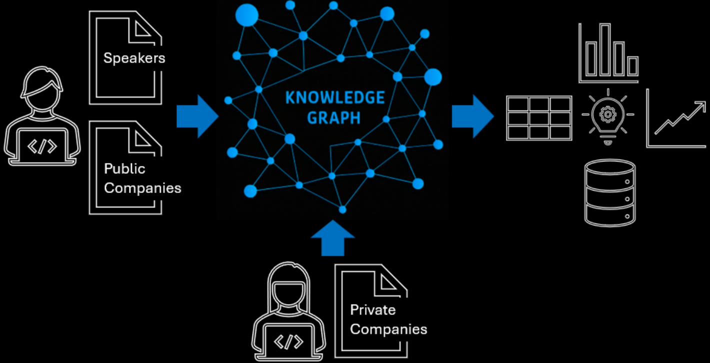
Generate RDF, align to FOAF ontology



File: ../tests/configs/generate_foaf_rdf.yaml

~~~yaml
api_url: "http://localhost:8000/v1"
model: "Qwen/Qwen3-30B-A3B-Instruct-2507"

messages:
  - role: "system"
    content: |
      You are an expert in RDF/OWL and the FOAF (Friend of a Friend) ontology.

      Your task is to convert a JSON array of speaker names into valid RDF/XML
      that complies with the FOAF ontology specification.

      FOAF Ontology Requirements:
      - Use the FOAF namespace: http://xmlns.com/foaf/0.1/
      - Each speaker should be represented as a foaf:Person
      - Use foaf:name for the full name
      - Use foaf:firstName and foaf:lastName for name components when possible
      - Generate unique URIs for each person (e.g., using hash of their name)
      - Include proper RDF/XML structure with namespaces

      RDF Structure Template:
      ```xml
      <?xml version="1.0" encoding="UTF-8"?>
      <rdf:RDF
          xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
          xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
~~~

Knowledge Graph Integration: Creating Knowledge from Disparate Data Sources

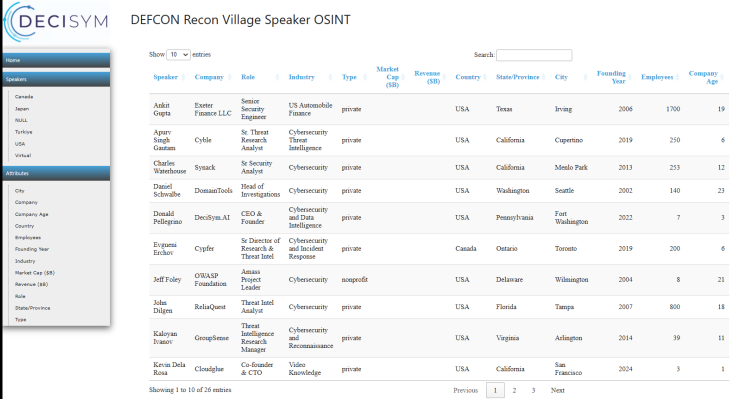


Knowledge Graph Integration: Speaker Company Analysis

- **Linked FOAF to Wikidata**
  - 28 speakers extracted
  - 7 companies matched in Wikidata
  - Founded 1935-2012
- **Industry Distribution**
  - Computer Security: 3
  - Information Technology: 2
  - Cybersecurity: 1
  - Agriculture: 1
- **Key Insight**: Mix of established companies (Microsoft, 50 years) and newer security firms (Synack, 13 years)

Company	Age
Tyson Foods	90 years
Microsoft	50 years
Fortinet	25 years
OWASP	24 years
Palo Alto Networks	20 years
Recorded Future	17 years
Synack	13 years

Knowledge Graph Integration: Dashboard



DEFCON Recon Village Speaker OSINT

Show 10 entries

Search:

Speaker	Company	Role	Industry	Type	Market Cap ($B)	Revenue ($B)	Country	State/Province	City	Founding Year	Employees	Company Age
Ankit Gupta	Exeter Finance LLC	Senior Security Engineer	US Automobile Finance	private			USA	Texas	Irving	2006	1700	19
Apurv Singh Gautam	Cyble	Sr. Threat Research Analyst	Cybersecurity Threat Intelligence	private			USA	California	Cupertino	2019	250	6
Charles Waterhouse	Synack	Sr Security Analyst	Cybersecurity	private			USA	California	Menlo Park	2013	253	12
Daniel Schwalbe	DomainTools	Head of Investigations	Cybersecurity	private			USA	Washington	Seattle	2002	140	23
Donald Pellegrino	DeciSym.AI	CEO & Founder	Cybersecurity and Data Intelligence	private			USA	Pennsylvania	Fort Washington	2022	7	3
Evgueni Erchov	Cypfer	Sr Director of Research & Threat Intel	Cybersecurity and Incident Response	private			Canada	Ontario	Toronto	2019	200	6
Jeff Foley	OWASP Foundation	Amass Project Leader	Cybersecurity	nonprofit			USA	Delaware	Wilmington	2004	8	21
John Dilgen	ReliaQuest	Threat Intel Analyst	Cybersecurity	private			USA	Florida	Tampa	2007	800	18
Kaloyan Ivanov	GroupSense	Threat Intelligence Research Manager	Cybersecurity and Reconnaissance	private			USA	Virginia	Arlington	2014	39	11
Kevin Dela Rosa	Cloudglue	Co-founder & CTO	Video Knowledge	private			USA	California	San Francisco	2024	3	1

Showing 1 to 10 of 26 entries

Previous 1 2 3 Next

Stack

- User decisions
  - Source selection (e.g., websites)
  - Salient feature identification (e.g., Speakers)
  - Ontology selection (e.g., FOAF)
- Tools
  - Workflow support (e.g., scripts, DeciSym.AI Engine, LM Studio)
  - Crawlers (e.g., Tor Arti)
  - Triplestore (e.g., DeciSym.AI Engine, Oxigraph)
- LLM
  - Model (e.g., Qwen3-30B-A3B-Instruct-2507)
  - Runtime (e.g., vLLM, Docker image rocm/vllm)
- Linux Distribution (e.g., Ubuntu 24.04.2 LTS)
- Hardware (e.g., AMD or Nvidia GPU)

Summary

- Bypass LLM rate limits by building a local cache of sources over time.
  - Sources can be reused and shared
  - Sources can be integrated
- Maintain OPSEC by working on local cache.
- Enable scientific repeatability and reusability with workflow management.

Contacts

- Recon Village: `https://www.reconvillage.org`
- Supplementary Materials: `https://github.com/DeciSym`
- Email: `don@decisym.ai`