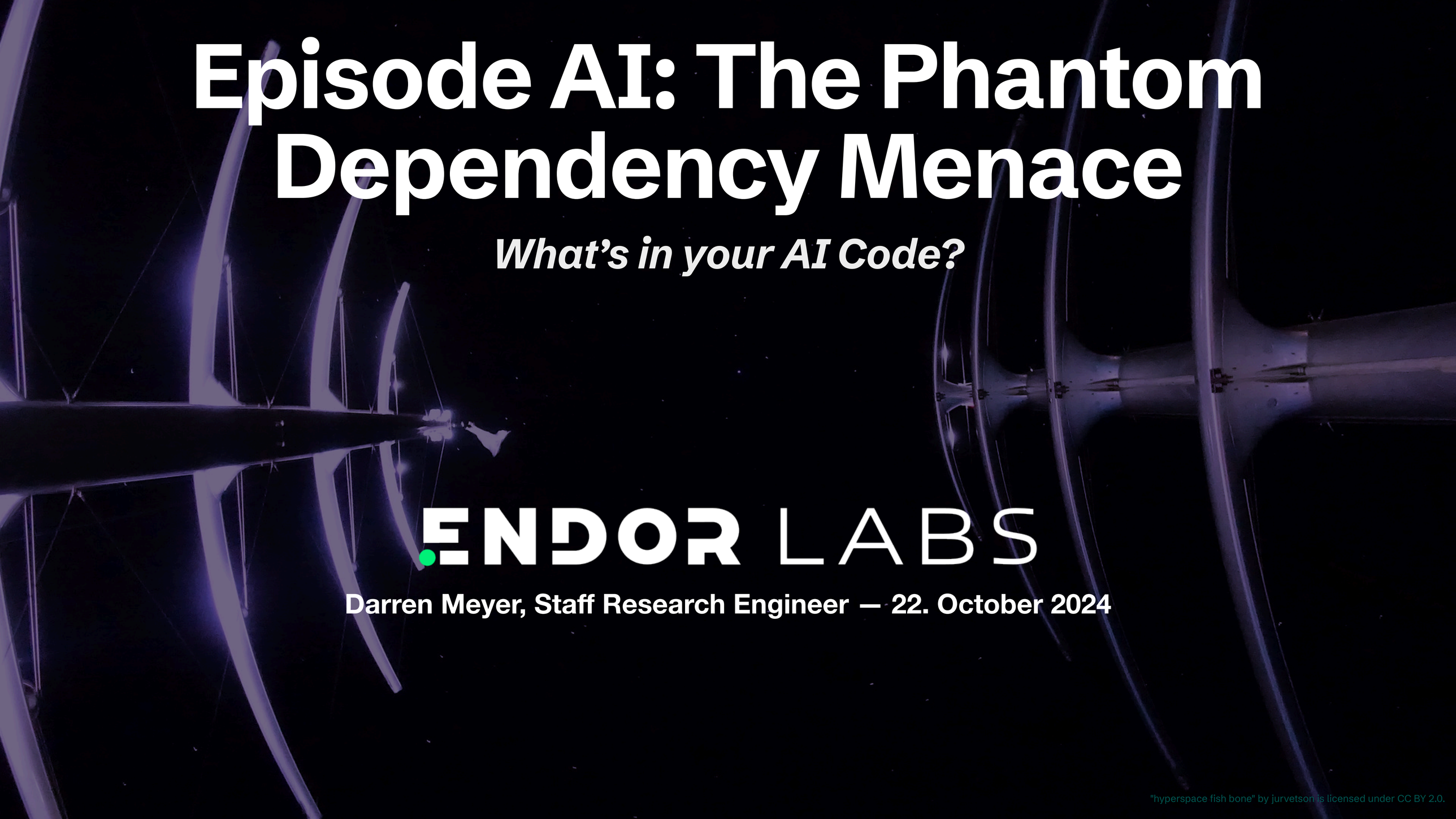
Episode AI: The Phantom Dependency Menace

What's in your AI Code?



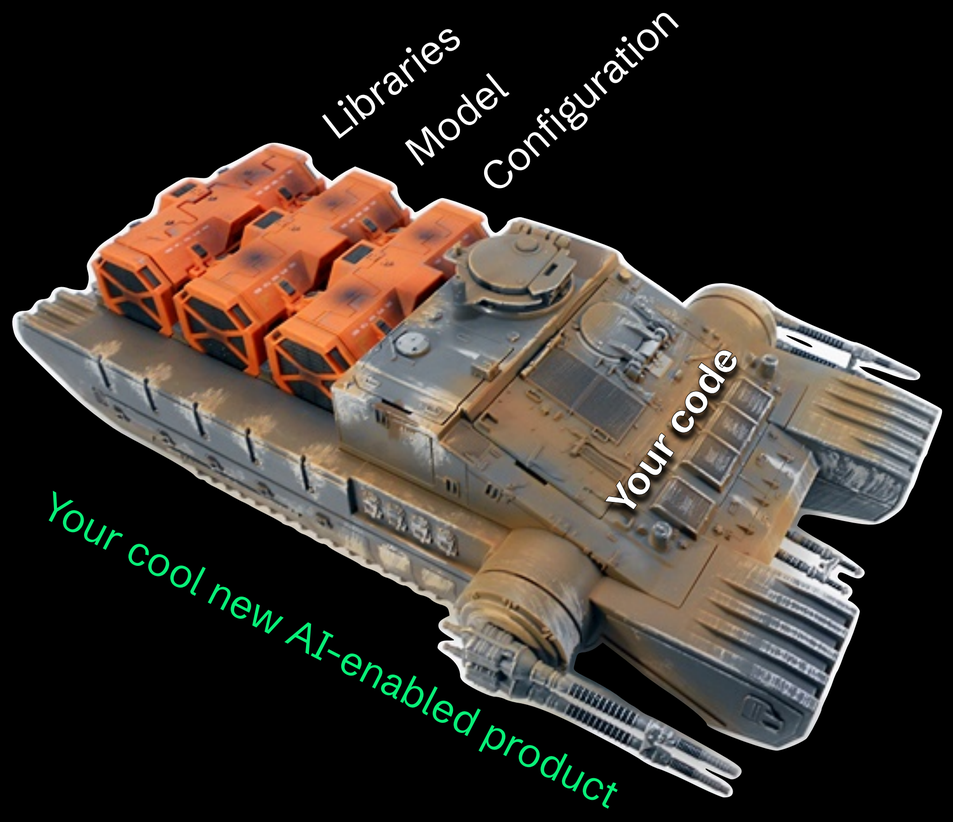
ENDOR LABS

Darren Meyer, Staff Research Engineer — 22. October 2024

Why me?

- 20 years in AppSec
  - Built and ran security programs
  - Practical researcher for over 9 years
- Software engineering background
- General nerd

What do we mean by “AI Code”?



How dependencies work

Package Managers and Runtimes tend to operate completely decoupled, like ships passing in the night

1. Developer creates a manifest file (requirements.txt, package.json, pom.xml, etc.) to declare direct dependencies

2. Build system runs package manager and the direct dependencies bring along several other transitive dependencies

3. Package manager copies the files in a directory

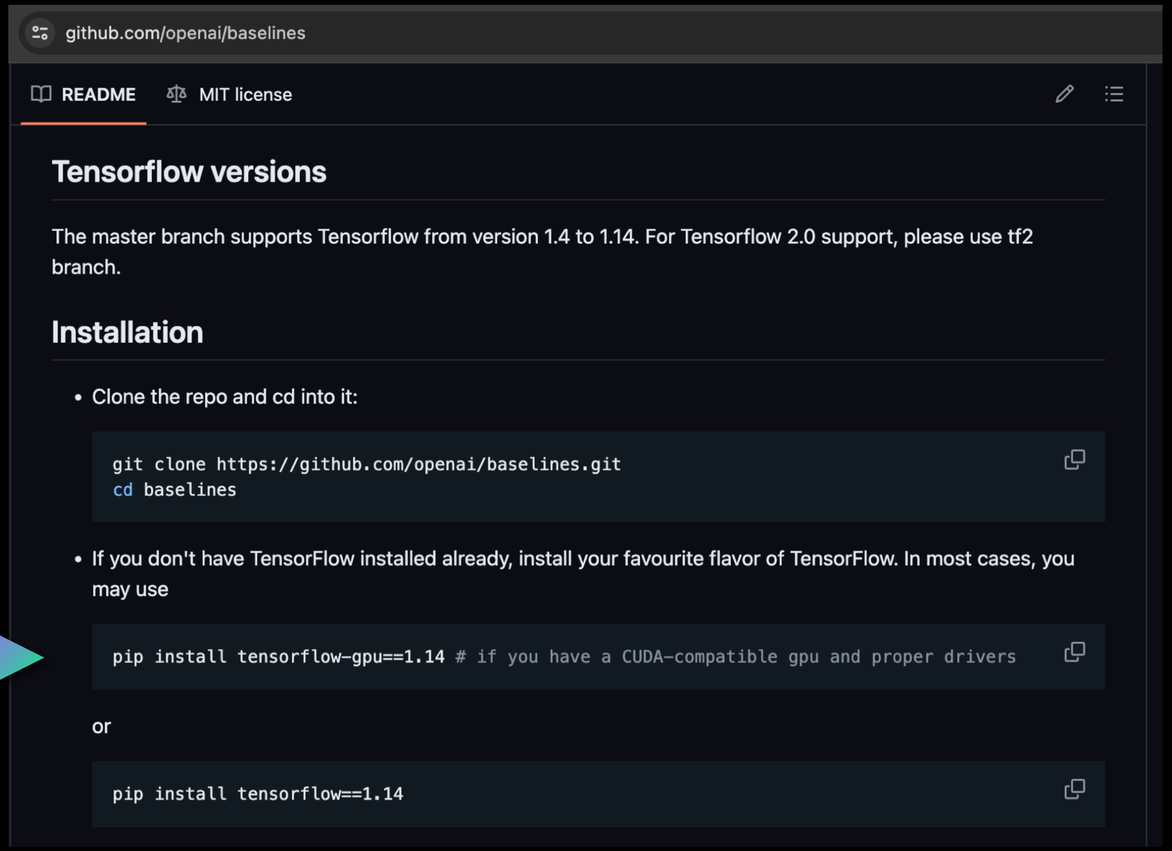
4. Runtime/compiler loads dependencies as needed during execution

Things get out of sync

It is unavoidable

- Developers import new dependencies without updating the manifest file (possible in python, Javascript, scripts etc)
- In some cases dependencies are there in the environment (like global python or node packages)
- In some cases dependencies are for testing/dev but unmarked or misused
- In some cases dependencies are removed from the code but not from the package manager manifests

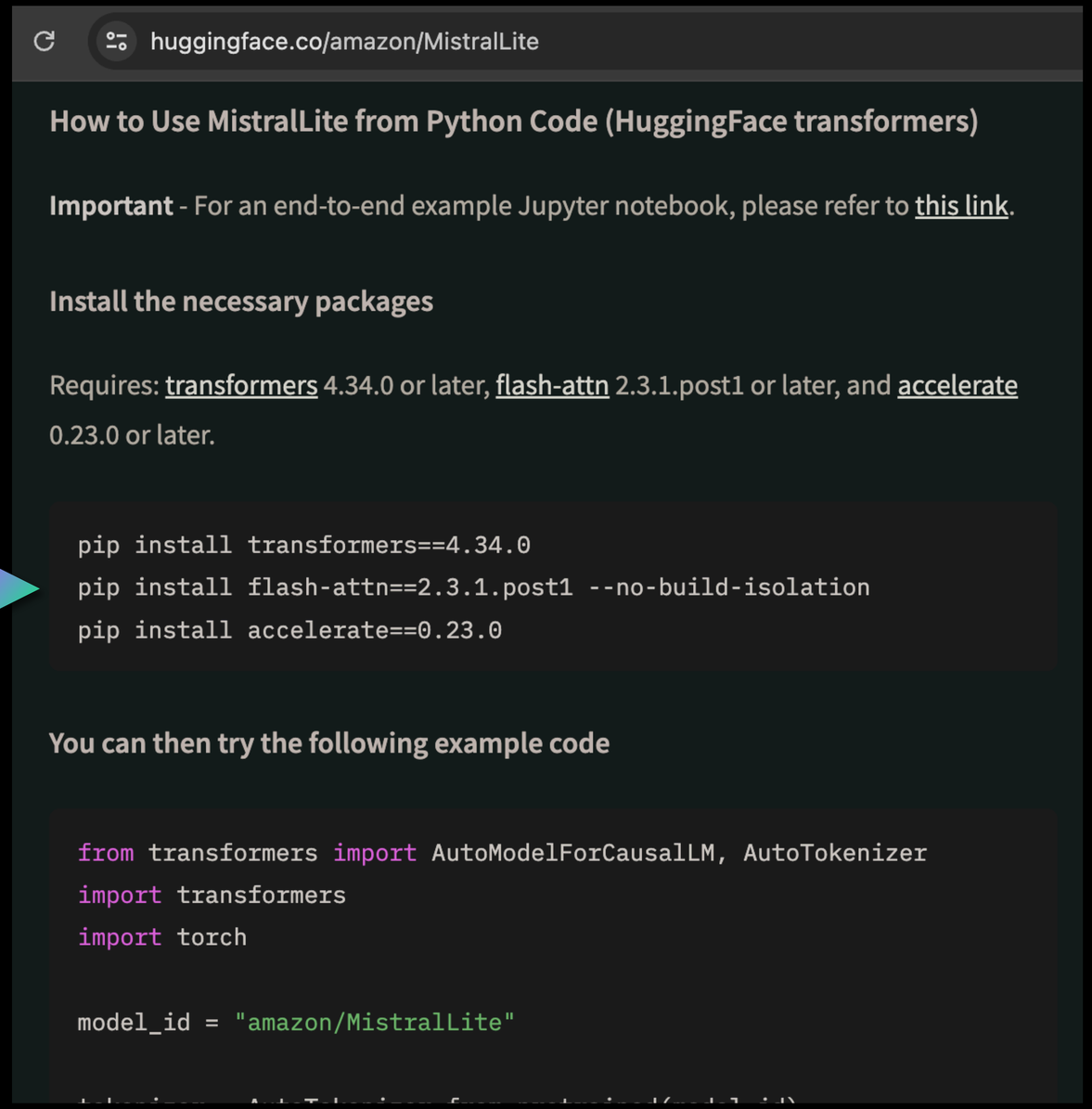
Your manifest can lie



OpenAI's Baselines library

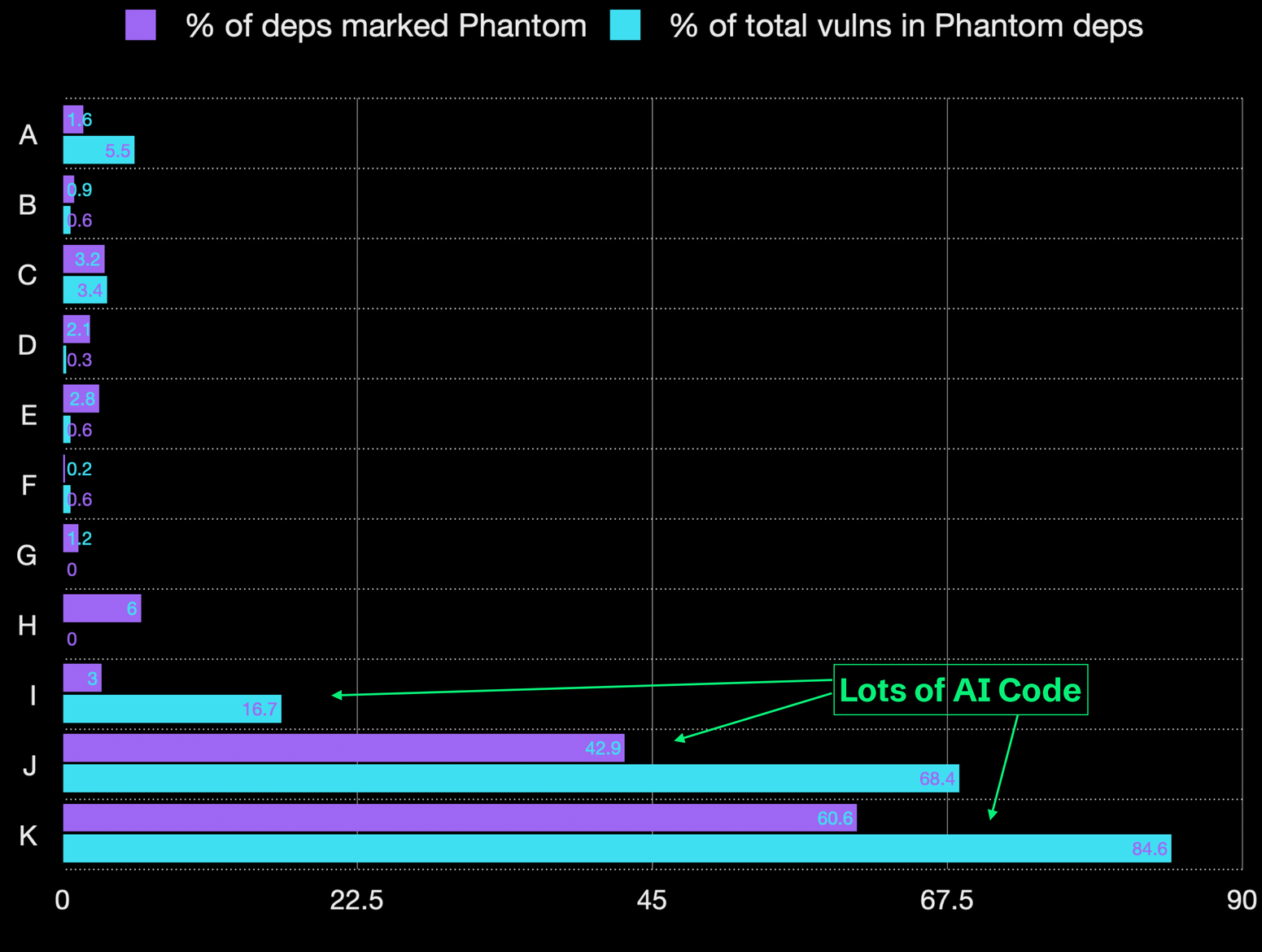
- "Just `pip install` a dep"
- Baselines *won't function without the right version*, but there are several "right versions"
- You'll never see it in a manifest or lock file
- SCA / dep tree tools (usually) won't see it

Models suggest this pattern often



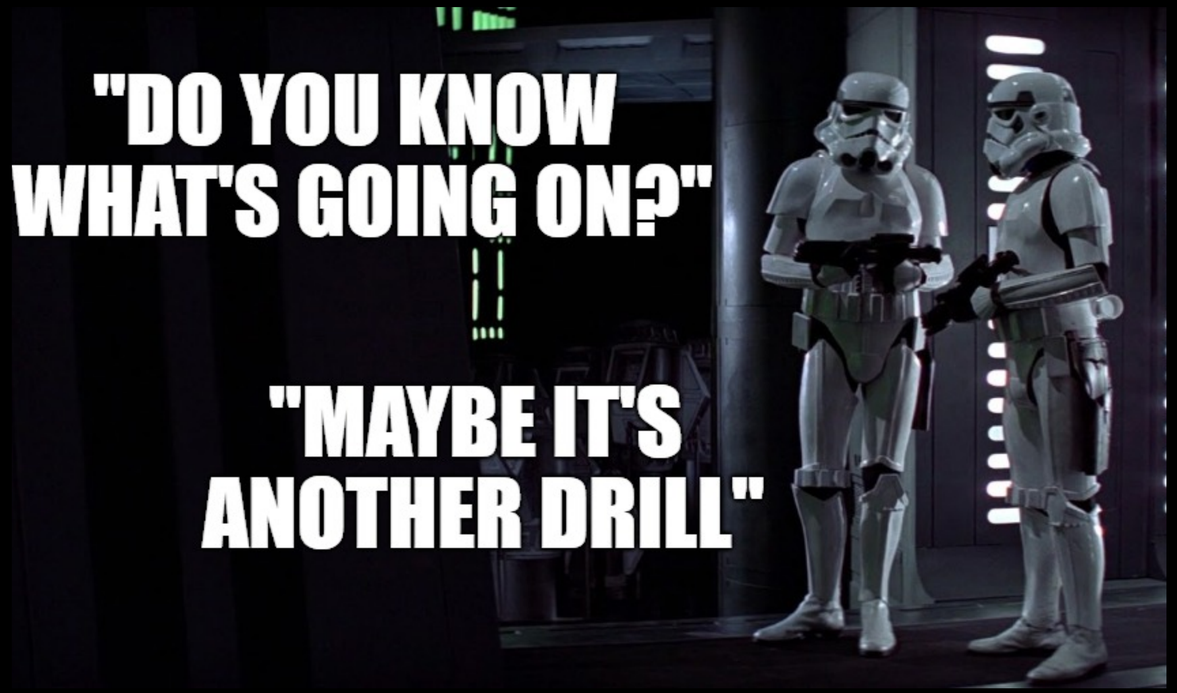
The Phantom Dependency Menace

- Dependencies that are either “provided” by the system are assumed to be downloaded manually
- Scripts, containers, and so on
- Often depend on the target platform



Security Challenges

- False sense of security — tools can’t see what’s not in a manifest, so you miss risks that might be relevant
- Inaccurate compliance data — your SBOMs aren’t reporting everything in use. Auditors are unhappy if they catch you
- Dev / prod differences — can’t rely on the version I see in dev pipelines being the same thing that’s in production



Most tools are blind

Many tools trust the manifest or lock files, and don't account for the ways those can lie

1. Phantom Dependencies (false negatives)
   - Brought by the system, runtime or other scripts
2. Mis-used dependencies (false negatives)
   - Dependencies brought as "test/dev" used in runtime
3. Direct use of transitives (unreliable fixing)
   - Dependencies brought in as transitives and used directly without knowledge
4. Unused dependencies (false positives and noise)
   - Dependencies brought in the manifest but not used by the code

Program Analysis FTW

What matters is which packages the code actually uses

1. Source of truth is actually the source code / bytecode
    a. Analyze the code
    b. Create an Abstract Syntax Tree
    c. Analyze types and call flows
    d. Create a call graph
2. Correlate the dependencies used by the code with the dependencies fetch by the package manager or available in the file system
3. Create a unified view

Example: Python

Use the source

1. Import dependency ▶ Call graph ▶ “Is it used?”
    a. Repeat for all it’s dependencies (transitive)
    b. Output: dependency graph
2. Compare dependency graph with versions installed on system and defined in manifest
3. Correlate and unify results
    a. Makes accurate SBOM and VEX possible

Made possible with help from

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original research, program analysis design

Jamie Scott
models, reviews

Many contributors to OSS projects and papers

← My LinkedIn

My Mastodon →
@darrenpmeyer@infosec.exchange