# CS 499 Computer Science Capstone 3-2 Milestone Two: Enhancement One: Software Design and Engineering

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## Enhancement One – Software Design & Engineering

### Artifact: animal\_shelter.py (MongoDB CRUD module)

#### Overview of the Artifact

The artifact is a Python CRUD module, animal\_shelter.py, used by my CS-340 Dash/Jupyter dashboard to interact with a MongoDB dataset of shelter animals. The enhanced version preserves the original public API (class and method names/signatures) while adding professional engineering features: docstrings and type hints, centralized logging with user-friendly messages, optional environment-driven configuration, fast connection checks (timeouts + ping), and conservative input validation (including a safe allow-list for update operators and support for read({}) to return all documents).

For context, the original baseline provided basic CRUD with minimal error handling and without structured logging or configuration controls.

#### Why I Included This Artifact

I selected this artifact because it shows practical software design applied to a real data workflow: an analytics UI backed by MongoDB through a reusable Python module. Key improvements demonstrate:

* **Quality & clarity:** Comprehensive docstrings and type hints that clarify intent and improve maintainability.
* **Observability:** Central logging (logging.basicConfig(...)) plus friendly print(...) messages for notebook users.
* **Portability:** Optional env-driven configuration (MONGO\_URI, MONGO\_DB, MONGO\_COLL) while retaining the original username/password path.
* **Reliability & safety:** Fast connection validation; \_validate\_filter(..., allow\_empty) so read({}) works with the dashboard; strict, operator-safe filters for update/delete; update allow-list and $-key guards.

(An earlier enhanced draft helped validate these changes during integration.)

#### Course Outcomes Addressed

* **Software engineering/design/database:** I applied configuration management, structured logging, input validation, and connection health checks to deliver a robust, maintainable CRUD layer—without breaking existing consumers.
* **Professional communication:** Clear docstrings and consistent logs communicate behavior to collaborators and provide helpful user feedback in notebooks.
* **Problem-solving with trade-offs:** Allowing empty filters only for reads (to support db.read({})) while keeping writes strict reflects deliberate design trade-offs between usability and safety.

#### Reflection on the Enhancement Process

What I learned. I reinforced PyMongo best practices (e.g., avoid truthiness checks on Collection; use timeouts and ping) and designed validation that fits the product context—supporting all-records reads for dashboards without weakening write safety.

##### **Challenges and Resolutions.**

* **Notebook compatibility:** Early strict validation rejected {}; adding \_validate\_filter(..., allow\_empty=True) resolved this for reads while keeping writes protected.
* **Library nuance:** Replacing if not self.collection: with if self.collection is None: avoided PyMongo’s NotImplementedError for truthiness checks.
* **Environment parity:** Case sensitivity (e.g., aac vs AAC) can cause write errors on some systems; aligning DB names and supporting env overrides eliminated these issues.

#### How the Artifact Was Improved (Concrete Changes)

* Added docstrings/type hints and central logging; preserved friendly print(...) messages for immediate UI feedback.
* Enabled env-driven configuration (URI/DB/COL) and fast-fail connection checks.
* Implemented filter validation with allow\_empty support for reads and a safe update allow-list with $-key guards.
* Preserved the original class/method structure for drop-in compatibility with dashboards and tests.

#### Possible Indicators of Success (Rubric Alignment)

* **Innovative techniques:** env-configurable connections, health checks, structured logging, and safe validators.
* **Programming solutions:** balanced read({}) support vs. strict write validation and operator allow-listing.
* **Security-aware design:** blocks top-level $ operators, prevents $-prefixed keys, restricts updates to a safe set.
* **Clear articulation via a working product:** enhanced module runs with the CS-340 dashboard and communicates status/errors clearly.