AVANOCHI: OFFICIAL TECHNICAL DOCUMENTATION

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Table of Contents

Introduction

This is the official documentation of the AVANOCHI project. Every code and architectural decision involved will be explained here in detail.

AVANOCHI is a productivity application with a playful and gamified approach, designed to enhance **time management**, **work performance**, and **well-being** during the workday. The project introduces a virtual companion — a “productive tamagotchi” — that not only motivates employees but also assists in organizing tasks, tracking performance, and promoting healthy work habits.

At its core, AVANOCHI bridges **task management**, **behavioral gamification**, and **AI-powered insights** to create an engaging system that goes beyond traditional productivity tools. Unlike conventional task trackers, AVANOCHI establishes an emotional connection with the user: the character reacts to the employee’s actions, encourages breaks, and evolves alongside the worker’s performance. This interaction transforms daily work into a dynamic and rewarding experience, increasing motivation while reducing stress and fatigue.

The platform is designed with **modularity** and **scalability** in mind, leveraging modern cloud resources and AI-driven features. It integrates with Microsoft Azure services for data storage, analytics, AI recommendations, and voice/chat interaction. This ensures that the system not only adapts to individual needs but also continuously improves through **machine learning and data-driven feedback**.

Purpose of the project

The main goal of AVANOCHI is to support employees in achieving higher productivity while maintaining a healthy work-life balance. To accomplish this, the system:

- Encourages **organization** through daily and weekly task management.
- Provides **real-time performance tracking** and visual statistics.
- Promotes **healthy habits** such as hydration, breaks, and proper lunch times.
- Uses **gamification elements** (achievements, rewards, character evolution) to increase engagement.
- Offers **personalized recommendations** powered by AI, adapting to each employee’s work rhythm.
- Predicts risks of **work overload and burnout**, sending alerts before they happen.
- Extends productivity beyond the app itself with **multichannel integration** (Teams, Slack, voice assistant).

In summary, AVANOCHI is not just a productivity app, but a **digital companion** that combines technology, gamification, and well-being to redefine the way employees interact with their workday.

1. General Architecture: Azure Functions

Avanochi is built on a **serverless architecture** using Microsoft Azure Functions. This approach was chosen to ensure scalability, modularity, and cost efficiency. Instead of relying on a traditional web server that requires continuous maintenance and resource allocation, serverless functions allow us to run code only when specific events are triggered. This event-driven model aligns perfectly with Avanochi's needs, where different modules—such as task tracking, AI recommendations, and health reminders—can operate independently without interfering with each other.

By adopting a serverless structure, we gain several advantages: reduced operational overhead, automatic scaling according to workload, and seamless integration with other Azure services like Cosmos DB, AI Foundry, and Speech Services. This design ensures that Avanochi remains lightweight yet powerful, focusing development efforts on **business logic and user experience** rather than infrastructure management.

1.1 AZ_functions directory

The AZ_functions module serves as the backbone of Avanochi's cloud logic. It organizes all serverless functions into thematic domains, each responsible for a specific aspect of the application. This modular layout naturally aligns with Azure Functions' event-driven model: each directory encapsulates functions tied to specific triggers and responsibilities.

Such organization simplifies both development and testing by isolating functionalities into independent domains. Each domain can evolve on its own lifecycle, making it easier to extend or replace components without affecting the rest of the system. The result is a clean, predictable architecture that supports continuous integration and long-term maintainability, while keeping the cloud logic transparent and easy to navigate.

1.1.1 Structure Overview

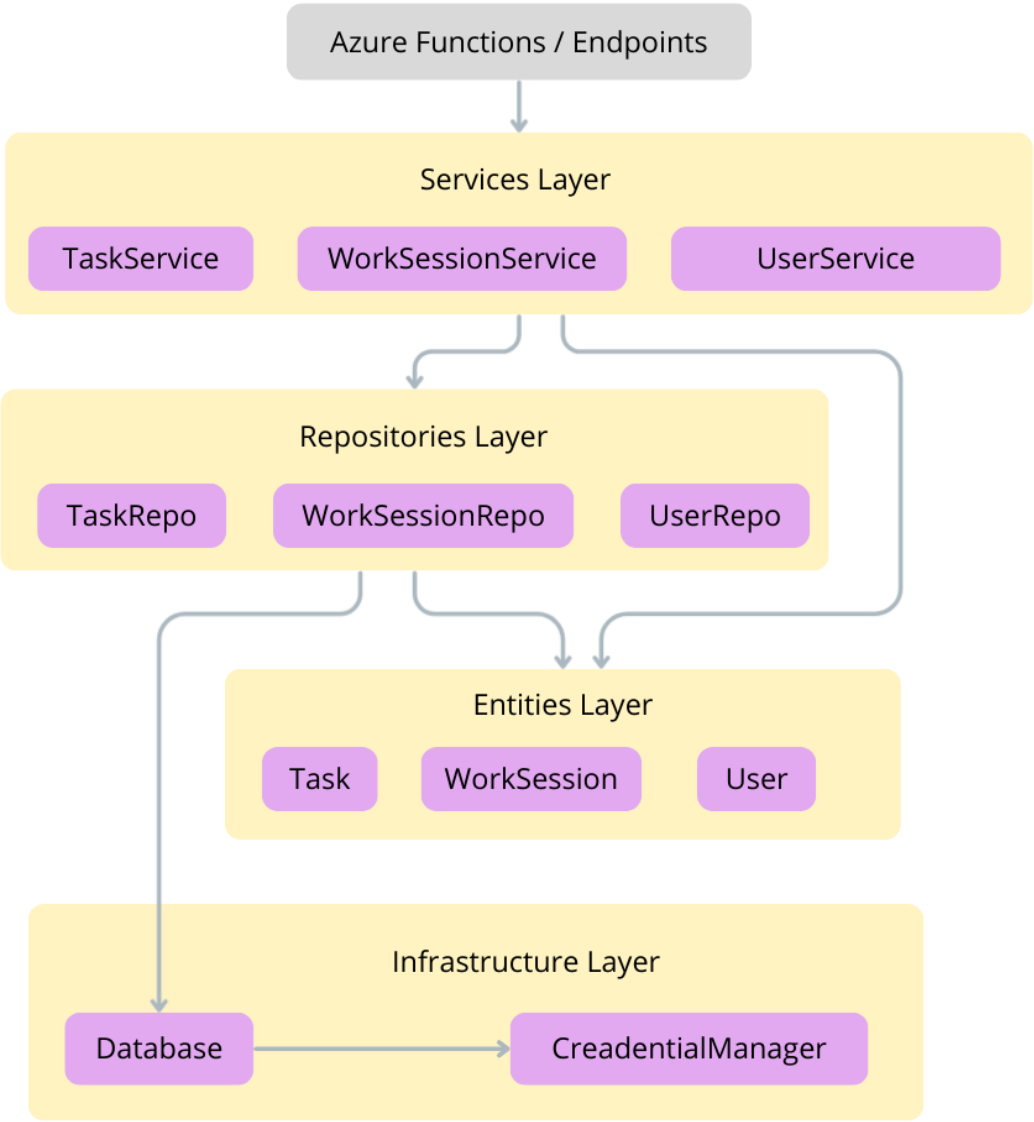
- `.shared/`: This module ensures consistency, reusability, and maintainability, reducing code duplication across the system.
    - Centralizes cross-cutting concerns and reusable components for all other modules.
    - init.py: Marks the package as importable and optionally exposes shared interfaces.
    - `credential_manager.py`: Handles secure authentication and credential rotation.
    - `database.py`: Defines the database connection layer and abstracts CRUD operations.
    - `entities/`: Declares data models and schemas used across functions.
    - `repos/`: Implements the repository pattern, linking entities with database logic.
    - `services/`: Provides high-level services that orchestrate business logic and integrations.
- `assistant/`
    - Includes AI-driven features such as *narratives*, *predictions*, and *recommendations*.
    - These functions process historical data, generate natural language summaries, and provide personalized insights to the user.
    - Acts as the decision-making hub of Avanochi's assistant role.
- `interaction/`
    - Handles user interaction layers such as bot communication, notifications, and voice integration.
    - Designed for multi-channel experiences, enabling seamless integration with chat platforms (Teams, Slack) and voice systems (Azure Speech Services).

- `health/`
    - Manages well-being functionalities: hydration, meals, and rests.
    - Functions here send reminders, track user inputs, and contribute to the healthy-life dimension of the project.
    - These elements directly influence the gamified Avanochi “persona”.
- `work/`
    - Dedicated to productivity tracking: achievements, stats, tasks, and work sessions.
    - Core logic for task management, progress measurement, and session recording resides here.
    - This module feeds most of the gamification system, unlocking achievements and performance insights.
- Configuration files
    - `host.json` and `local.settings.json` define the runtime environment and local development setup.
    - Ensure consistency between cloud deployment and local testing
- `templates/`
    - Stores pre-defined templates such as `cosmosdb.json`
    - Provides ready-to-use schemas for database bindings and resource definitions

`.shared` Architecture

The `.shared` module is a foundational layer that centralizes all cross-cutting concerns within the AZ_functions ecosystem. It ensures that domain-specific functions (assistant, health, interaction, work) can focus purely on their logic, while shared components provide common services, models, and infrastructure handling.

Here we have an structural Overview of the logic it follows:



Credential Manager

This module is responsible for managing authentication and secure access to the project's external resources, such as **CosmosDB**, **Azure services**, or third-party APIs. It centralizes all credential-related logic, including retrieval from secure environments and, when required, automatic rotation of secrets. By handling this complexity in one place, the rest of the system is shielded from directly managing tokens or sensitive keys. This not only reduces the exposure of confidential information but also ensures compliance with security best practices. In essence, it acts as a security gateway, guaranteeing that all external connections are performed safely and consistently.

The main working logic can be divided into two main functions:

- **General method `get()`**
  This method will get an input of the expected key and a default value, so that any key can be looked up for in the credential library. if no key is found, it will return the default value

  ```
  def get(self, key: str, default: str = None):
      # Retrieve any environment variable by key.
      return os.getenv(key, default)
  ```

- **Specific methods**
  For each service that requires authentication methods through API keys or special endpoints, there will be specific methods such as the `get_cosmos_credentials()` method, that will return a list of keys only needed in the `CosmosDBService` class. any other service method shall be coded in `CredentialManager` class to keep a clean use of the credential extraction and not abuse the `get()` method

  ```
  def get_cosmos_credentials(self):
      # Retrieve Cosmos DB credentials from environment variables.
      return {
          "account_name": os.getenv("COSMOS_DB_ACCOUNT", ""),
          "database_name": os.getenv("COSMOS_DB_DATABASE", ""),
          "container_name": os.getenv("COSMOS_DB_CONTAINER", ""),
          "uri": os.getenv("COSMOS_DB_URI", ""),
          "primary_key": os.getenv("COSMOS_DB_PRIMARY_KEY", "")
      }
  ```

Database: CosmosDB

This module is responsible for handling all interactions with Azure Cosmos DB, ensuring that data persistence is managed in a centralized and secure manner. The CosmosDBService class abstracts the complexity of creating and maintaining the connection to Cosmos DB, making sure that the required database and container exist before any operation is performed. By depending exclusively on the `CredentialManager` to retrieve its credentials, this class adheres to the Single Responsibility Principle, keeping authentication logic separated from database logic. This approach guarantees scalability, maintainability, and consistent usage of environment-based configurations. The main responsibilities can be divided into the following components:

- **Initialization (`__init__`)**: The constructor receives a `CredentialManager` instance and prepares the service for interacting with Cosmos DB.
  At this stage, only the credential manager is stored. Depending on the chosen strategy, the database connection may be established immediately (**eager initialization**) or deferred until needed (**lazy initialization**).

```
def __init__(self, credential_manager: CredentialManager):
    self._credential_manager = credential_manager
    self._client = None
    self._database = None
    self._container = None
```

- **Lazy Connection Handling (`_ensure_connection`)**: This private method guarantees that the **Cosmos DB client, database, and container are initialized**. It is invoked internally by CRUD operations before performing any interaction with the database. This approach ensures that the service can start even if Cosmos DB is temporarily unavailable during app startup, making it ideal for Azure Functions.

```
def _ensure_connection(self):
    if self._client is None:
        creds = self._credential_manager.get_cosmos_credentials()
        url = creds["uri"]
        key = creds["primary_key"]
        database_name = creds["database_name"]
        container_name = creds["container_name"]

        # Create client and ensure database + container
        self._client = CosmosClient(url, key)
        self._database =
self._client.create_database_if_not_exists(id=database_name)
        self._container = self._database.create_container_if_not_exists(
            id=container_name,
            partition_key=PartitionKey(path="/id"),
            offer_throughput=400
        )
```

- **Database methods**: The `CosmosDBService` provides a set of generic CRUD methods and query execution helpers that abstract direct interaction with Cosmos DB:
    - `create_item()`: Inserts a new document into the container. Automatically generates a unique `id` if not provided and validates the presence of a `user_id`.

```
def create_item(self, item: dict) -> dict:
    try:
        # Ensure unique ID
        if "id" not in item:
            item["id"] = str(uuid.uuid4())

        if "user_id" not in item:
            raise DatabaseError("Missing required field: 'user_id'")

        created = self._container.create_item(body=item)
        logging.info(f"Item created with id={created['id']}")
        return created
    except exceptions.CosmosHttpResponseError as e:
        logging.error(f"Failed to create item: {e.message}")
        raise DatabaseError(f"Failed to create item: {e.message}") from e
```

- `read_item()`: Retrieves a single document by its `id` and partition key. Raises a `DatabaseError` if the item is not found.

```
def read_item(self, item_id: str, partition_key: str) -> dict:
    try:
        return self._container.read_item(item=item_id,
partition_key=partition_key)
    except exceptions.CosmosResourceNotFoundError:
        raise DatabaseError(f"Item with id '{item_id}' not found.")
    except exceptions.CosmosHttpResponseError as e:
        raise DatabaseError(f"Failed to read item '{item_id}': {e.message}") from
e
```

- `upsert_item()`: Inserts or updates a document. Ensures that `id` and `user_id` are present before performing the operation.

```
def upsert_item(self, item: dict) -> dict:
    try:
        if "id" not in item:
            item["id"] = str(uuid.uuid4())

        if "user_id" not in item:
            raise DatabaseError("Missing required field: 'user_id'")

        upserted = self._container.upsert_item(body=item)
        logging.info(f"Item upserted with id={upserted['id']}")
        return upserted
    except exceptions.CosmosHttpResponseError as e:
        logging.error(f"Failed to upsert item: {e.message}")
        raise DatabaseError(f"Failed to upsert item: {e.message}") from e
```

- `delete_item()`: Deletes a document by its `id` and partition key. Logs the deletion attempt and raises a `DatabaseError` if the item does not exist.

```
def delete_item(self, item_id: str, partition_key: str) -> None:
    try:
        logging.info(f"Attempting to delete item with id={item_id}")
        self._container.delete_item(item=item_id, partition_key=partition_key)
    except exceptions.CosmosResourceNotFoundError:
        raise DatabaseError(f"Item with id '{item_id}' not found, cannot
delete.")
    except exceptions.CosmosHttpResponseError as e:
        raise DatabaseError(f"Failed to delete item '{item_id}': {e.message}")
from e
```

- `send_query()`: Executes a custom SQL-like query against the container, supporting optional parameters and cross-partition queries. Debug logs include the query and provided parameters.

```
def send_query(self, query: str, parameters: list = None) -> list[dict]:
    if parameters is None:
        parameters = []
    try:
        logging.debug(f"Executing query: {query} | Parameters: {parameters or
'None'}")
        results = self._container.query_items(
            query=query,
            parameters=parameters,
            enable_cross_partition_query=True
        )
        return [item for item in results]
    except exceptions.CosmosHttpResponseError as e:
        raise DatabaseError(f"Query failed: {e.message}") from e
```

Entities

This module defines the **core domain entities** of the application.
Entities are plain Python classes that represent the business objects of Avanochi, such as **tasks**, **work sessions**, and **users**.

They are designed with the **Single Responsibility Principle (SRP)** in mind:

- They only handle their own state and basic transformations.
- They are not aware of database operations or business orchestration.
- They provide serialization methods (`to_dict`) so that higher layers (repositories, services) can persist or transport them as dictionaries/JSON.

The folder structure will be explained bellow with each entity:

```
shared/
└── entities/
    ├── task.py
    ├── work_session.py
    └── user.py
```

- **Entity Tasks** Represents a single task in the system, having the following fields:
    - `id`: unique identifier (UUID)
    - `title`: short description of the task
    - `completed`: boolean status (default `false`)
    - `created_at`: UTC timestamp of the creation (ISO format)
    - `updated_at`: timestamp of the last update (optional)

  It contains only one method to return the `task` as a dictionary:

```
def to_dict(self):
    return self.__dict__
```

  The output would be something like this:

```
{
    "id": "3b9f7b8e-6d7a-4e3f-a23c-5a0efb9b72c9",
    "title": "Finish project report",
    "completed": false,
    "created_at": "2025-09-25T10:15:30.123456",
    "updated_at": null
}
```

- **Entity WorkSession** Represents a session of productive work for a given user, having the following fields:
    - `id`: unique identifier (UUID)
    - `user_id`: identifier of the user who owns the session
    - `start_time`: UTC timestamp when the session started (ISO format).
    - `end_time`: UTC timestamp when the session ended (ISO format).
    - `duration`: session length in hours, stored as a float (rounded to 2 decimals).

  It contain two methods:

    - `end_session()`: sets the end_time to current UTC time and calculates duration in hours.
    - `to_dict()`: returns the session as a dictionary for storage or serialization.

```
def end_session(self):
    self.end_time = datetime.utcnow().isoformat()
    start = datetime.fromisoformat(self.start_time)
    end = datetime.fromisoformat(self.end_time)
    self.duration = round((end - start).total_seconds() / 3600, 2)

def to_dict(self):
    return self.__dict__
```

example dictionary structure after ending a session:

```
{
    "id": "f49d0c33-b6cf-4d77-a274-8903b38c8ed2",
    "user_id": "user_123",
    "start_time": "2025-09-25T09:00:00.000000",
    "end_time": "2025-09-25T11:30:00.000000",
    "duration": 2.5
}
```

- **Entity User** Represents a user of the system.

  Fields:

  - `id`: unique identifier (UUID)
  - `name`: display name of the user
  - `created_at`: UTC timestamp of user creation (ISO format)
  - `updated_at`: timestamp of the last update (optional)

  It contains only one method to return the `user` as a dictionary:

  ```
  def to_dict(self):
      return self.__dict__
  ```

  output would be something like this:

  ```
  {
      "id": "21e4e82b-03d2-4e15-8d73-ff3b8737f8b0",
      "name": "Alice",
      "created_at": "2025-09-26T08:15:45.123456",
      "updated_at": null
  }
  ```

Repositories

Repositories provide the formal interface to the persistence layer: they are the only components that encapsulate direct data access logic and present a consistent API for the rest of the application. Note that services are the layer that should be called by endpoints—services orchestrate business logic and call repositories; endpoints must not access CosmosDBService or CredentialManager directly, as those are implementation details of the persistence layer.

In practice, repositories define the **data access layer** of the application.
They are responsible for persisting and retrieving domain entities, designed with the **Single Responsibility Principle (SRP)** in mind:

- They only handle communication with the database.
- They are not aware of business logic or entity rules.
- They provide a clean abstraction that services can use without depending on database details.

The folder structure will be explained bellow with each repo:

```
shared/
└── repos/
    ├── base_repo.py
    ├── stats_repo.py
    ├── task_repo.py
    ├── user_repo.py
    └── work_session_repo.py
```

- **BaseRepository**
  `BaseRepository` is an **abstract class** that defines generic CRUD operations and query execution.
  All concrete repositories inherit from this base class and implement their own `entity_type()` to identify the type of document they manage in the database.

  The methods provided are the following:

  - `create(entity: dict) -> dict`
    Persists a new entity in the database. The repository automatically injects its `type` before delegating to Cosmos. Returns the stored entity as a dictionary.
  - `get(entity_id: str) -> dict`
    Retrieves a single entity by its unique identifier. If the entity does not exist, a `DatabaseError` will be raised.
  - `update(entity: dict) -> dict`
    Updates an existing entity in the database, or creates it if it does not exist (Cosmos upsert operation). Returns the updated entity as a dictionary.
  - `delete(entity_id: str) -> None`
    Deletes an entity by its unique identifier. If the entity does not exist, the operation raises a `DatabaseError`.
  - `query(query: str, params: list = None) -> list[dict]`
    Executes a SQL-like query against the container. Parameters can be passed as a list of dictionaries (`{"name": ..., "value": ...}`). Returns a list of matching entities.

  By extending `BaseRepository`, all repositories benefit from these generic operations without duplicating code.

- **StatsRepository** Manages stats from the ecosystem, does not have an entity of it own, but all the statistics will be managed through this repository.

  Methods:

  - `count_completed_tasks(self, user_id: str)`: returns a total count of the completed tasks for selected user

    ```
    def count_completed_tasks(self, user_id: str) -> int:
        query = """
            SELECT VALUE COUNT(1)
            FROM c
            WHERE c.type = @type
            AND c.user_id = @user_id
            AND c.completed = true
        """
        params = [
            {"name": "@type", "value": "task"},
            {"name": "@user_id", "value": user_id}
        ]
        try:
            result = self.query(query, params)
            return result[0] if result else 0
        except Exception as e:
            raise DatabaseError(f"Error counting completed tasks: {e}")
    ```

- **TaskRepository**
  Manages `Task` entities.

  Methods:

  - `create_task(task: Task)`: persists a new task.

    ```
    def create_task(self, task: Task | dict):
        # Accepts Task entity or dict
        if isinstance(task, Task):
            return self.create(task.to_dict())
        return self.create(task)
    ```

  - `list_tasks()`: retrieves all tasks.

    ```
    def list_tasks(self):
        query = "SELECT * FROM c WHERE c.type = @type"
        params = [{"name": "@type", "value": self.entity_type()}]
        return self.query(query, params)
    ```

  - `list_tasks_by_user(user_id: str)`: retrieves all tasks for a selected user.

    ```
    def list_tasks_by_user(self, user_id: str):
        query = "SELECT * FROM c WHERE c.type = @type AND c.user_id =
    @user_id"
        params = [
            {"name": "@type", "value": self.entity_type()},
            {"name": "@user_id", "value": user_id}
        ]
        return self.query(query, params)
    ```

  - `complete_task(task_id: str)`: marks a task as completed.

    ```
    def complete_task(self, task_id: str):
        task = self.get(task_id)
        task["completed"] = True
        return self.update(task)
    ```

- **WorkSessionRepository**
  Manages `WorkSession` entities.

  Methods:

  - `start_session(session: WorkSession)`: persists a new work session.

    ```
    def start_session(self, session: WorkSession):
        return self.create(session.to_dict())
    ```

  - `end_session(session_id: str)`: closes an existing session and updates its duration.

    ```
    def end_session(self, session_id: str):
        session = self.get(session_id)
        ws = WorkSession(user_id=session["user_id"],
    start_time=session["start_time"])
        ws.id = session_id
        ws.end_session()
        return self.update(ws.to_dict())
    ```

  - `get_active_session(user_id: str)`: returns the current active session for a user.

    ```
    def get_active_session(self, user_id: str):
        query = "SELECT * FROM c WHERE c.type = @type AND c.user_id =
    @user_id AND IS_NULL(c.end_time)"
        params = [{"name": "@type", "value": self.entity_type()}, {"name":
    "@user_id", "value": user_id}]
        results = self.query(query, params)
        return results[0] if results else None
    ```

  - `list_sessions(user_id: str)`: retrieves all sessions for a given user.

    ```
    def list_sessions(self, user_id: str):
        query = "SELECT * FROM c WHERE c.type = @type AND c.user_id =
    @user_id"
        params = [{"name": "@type", "value": self.entity_type()}, {"name":
    "@user_id", "value": user_id}]
        return self.query(query, params)
    ```

- **UserRepository**
  Manages `User` entities.

  Methods:

  - `create_user(user: User)`: persists a new user.

    ```
    def create_user(self, user: User):
        # Persist a new user in the database
        return self.create(user.to_dict())
    ```

  - `get_user(user_id: str)`: retrieves a user by ID.

    ```
    def get_user(self, user_id: str):
        # Retrieve a single user by ID
        return self.get(user_id)
    ```

  - `update_user(user: User)`: updates an existing user.

    ```
    def update_user(self, user: User):
        # Update an existing user
        return self.update(user.to_dict())
    ```

  - `delete_user(user_id: str)`: deletes a user by ID.

    ```
    def delete_user(self, user_id: str):
        # Delete a user by ID
        return self.delete(user_id)
    ```

  - `list_users()`: lists all users in the database.

    ```
    def list_users(self):
        # List all users in the database
        query = "SELECT * FROM c WHERE c.type = @type"
        params = [{"name": "@type", "value": self.entity_type()}]
        return self.query(query, params)
    ```

Services

This directory defines the **business logic layer** of the application.
Services orchestrate operations on domain entities and delegate persistence to repositories.

They are designed with **Single Responsibility Principle (SRP)** in mind:

- They only handle the application logic and orchestration.
- They are not aware of database implementations or infrastructure details.
- They rely on repositories to persist or retrieve domain entities.

In practice, **services act as the API of the application**: they are the only entry point that higher layers (such as Azure Functions or REST endpoints) should use.
Repositories are never called directly from outside — all interactions must go through services.

The folder structure will be explained bellow with each service:

```
shared/
└── entities/
    ├── base_service.py
    ├── service_factory.py
    ├── stats_service.py
    ├── task_service.py
    ├── user_service.py
    └── work_session_service.py
```

- **BaseService**
  An abstract base class that defines a contract for all services in the application.

  It exposes the following method:

  - `get_entity_type() -> str`: returns the type of entity handled by the service (e.g., `"Task"`, `"WorkSession"`, `"User"`).

  All services inherit from this class to ensure consistency across the application.

- **ServiceFactory** A class that will ensure to build all the services and return them in different methods. this class exist to ensure SOLID architecture and avoid giving access to `Repositories` to the endpoints

  This class have an initialization that creates an instance of the database and each repo:

  ```
  def __init__(self):
      # Initialize shared infrastructure once
      cred_manager = CredentialManager()
      db_service = CosmosDBService(cred_manager)

      # Initialize repositories
      self._task_repo = TaskRepository(db_service)
      self._ws_repo = WorkSessionRepository(db_service)
      self._stats_repo = StatsRepository(db_service)
  ```

  Here is an example of some of the service methods:

  ```
  def get_task_service(self) -> TaskService:
      return TaskService(self._task_repo)

  def get_stats_service(self) -> StatsService:
      return StatsService(self._stats_repo, self._ws_repo)

  def get_work_session_service(self) -> WorkSessionService:
      return WorkSessionService(self._ws_repo)
  ```

- **StatsService** Provides the logic to access the `StatsRepository` from certain endpoints.

  It exposes the following methods:

  - `get_user_stats(user_id: str)`: returns all the basic stats for selected user.

    ```
    def get_user_stats(self, user_id: str) -> dict:
        if not user_id:
            raise ValueError("user_id is required")

        # Hours worked
        sessions = self.ws_repo.list_sessions(user_id)
        total_hours = sum(float(s["duration"]) for s in sessions if
    s.get("duration"))

        # Tasks completed
        tasks_completed = self.stats_repo.count_completed_tasks(user_id)

        return {
            "user_id": user_id,
            "hours_worked": round(total_hours, 2),
            "tasks_completed": tasks_completed
        }
    ```

- **TaskService**
  Provides the application logic for creating, listing, and completing tasks.
  This service validates input (such as empty titles) and creates `Task` entities before delegating persistence to the `TaskRepository`.

  It exposes the following methods:

  - `create_task(user_id: str, title: str)`: creates a new Task entity and persists it through the repository.

    ```
    def create_task(self, user_id: str, title: str) -> dict:
        if not title or title.strip() == "":
            raise ValueError("Task title cannot be empty")
        if not user_id:
            raise ValueError("Task must be associated to a user_id")

        task = Task(title)
        task_dict = task.to_dict()
        task_dict["user_id"] = user_id
        return self.repo.create_task(task_dict)
    ```

  - `list_tasks(user_id: str)`: retrieves all tasks from the repository.

    ```
    def list_tasks(self, user_id: str = None) -> list:
        if user_id:
            return self.repo.list_tasks_by_user(user_id)
        return self.repo.list_tasks()
    ```

  - `complete_task(task_id: str)`: marks a task as completed and updates it through the repository.

    ```
    def complete_task(self, task_id: str) -> dict:
        return self.repo.complete_task(task_id)
    ```

  Example result after creating a task:

  ```
  {
      "id": "3b9f7b8e-6d7a-4e3f-a23c-5a0efb9b72c9",
      "title": "Finish project report",
      "completed": false,
      "created_at": "2025-09-25T10:15:30.123456",
      "updated_at": null
  }
  ```

- **WorkSessionService**
  Provides the application logic for starting, ending, and listing productive work sessions.
  This service validates input (such as missing `user_id`) and creates `WorkSession` entities before delegating persistence to the `WorkSessionRepository`.

  It exposes the following methods:

  - `start_session(user_id: str)`: creates a new WorkSession entity for the given user and persists it through the repository.

    ```
    def start_session(self, user_id: str):
        if not user_id:
            raise ValueError("User ID is required to start a session")
        session = WorkSession(user_id)
        return self.repo.start_session(session)
    ```

  - `end_session(session_id: str)`: closes an existing session by calculating its duration and updating it through the repository.

    ```
    def end_session(self, session_id: str):
        return self.repo.end_session(session_id)
    ```

  - `get_active_session(user_id: str)`: retrieves the currently active session for the given user.

    ```
    def get_active_session(self, user_id: str):
        return self.repo.get_active_session(user_id)
    ```

  - `list_sessions(user_id: str)`: retrieves all sessions associated with the given user.

    ```
    def list_sessions(self, user_id: str):
        return self.repo.list_sessions(user_id)
    ```

  Example result after ending a session:

  ```
  {
      "id": "f49d0c33-b6cf-4d77-a274-8903b38c8ed2",
      "user_id": "user_123",
      "start_time": "2025-09-25T09:00:00.000000",
      "end_time": "2025-09-25T11:30:00.000000",
      "duration": 2.5
  }
  ```

- **UserService**
  Provides the application logic for creating, retrieving, updating, and deleting users.
  This service validates input (such as empty names) and creates `User` entities before delegating persistence to the `UserRepository`.

  It exposes the following methods:

  - `create_user(name: str)`: creates a new User entity and persists it through the repository.

    ```
    def create_user(self, name: str):
        if not name or name.strip() == "":
            raise ValueError("User name cannot be empty")
        user = User(name)
        return self.repo.create_user(user)
    ```

  - `get_user(user_id: str)`: retrieves a user by ID from the repository.

    ```
    def get_user(self, user_id: str):
        return self.repo.get_user(user_id)
    ```

  - `update_user(user: User)`: updates an existing user in the repository.

    ```
    def update_user(self, user: User):
        return self.repo.update_user(user)
    ```

  - `delete_user(user_id: str)`: deletes a user from the repository.

    ```
    def delete_user(self, user_id: str):
        return self.repo.delete_user(user_id)
    ```

  - `list_users()`: retrieves all users from the repository.

    ```
    def list_users(self):
        return self.repo.list_users()
    ```

  Example result after creating a user:

  ```
  {
      "id": "a8c91a7e-4a3b-45c1-9f27-97c847cf3d11",
      "name": "Alice",
      "created_at": "2025-09-25T14:45:00.000000",
      "updated_at": null
  }
  ```

Endpoints: `work` Directory

The `work` directory contains the core productivity features of Avanochi.
It exposes three main endpoints — **tasks**, **work_sessions**, and **stats** — each one implemented as an Azure Function.
Together, they provide the minimal viable product (MVP) for tracking productivity:
users can create and complete tasks, log their working sessions, and retrieve basic performance statistics.

Stats Endpoint

The **Stats** endpoint provides aggregated insights about a user's productivity.
Unlike **Tasks** and **WorkSessions**, which manage raw data, the Stats endpoint focuses on *summarization* and *reporting*.
It queries Cosmos DB for completed tasks and finished sessions, then calculates metrics such as total tasks, completed tasks, total time worked, and active streaks.
This endpoint is essential for powering the gamification and feedback systems of Avanochi.
All logic is orchestrated by the `WorkSessionService` and `TaskService`, which in turn delegate to their repositories.

- **GET /api/stats?user_id=...**
  Retrieve productivity statistics for a given user.
  The endpoint requires a `user_id` query parameter. It then fetches:
    - All tasks of the user via `TaskRepository`.
    - All sessions of the user via `WorkSessionRepository`.
      From these, it computes aggregate values such as:
    - `total_tasks`: number of tasks created.
    - `completed_tasks`: number of tasks marked as completed.
    - `total_sessions`: number of finished work sessions.
    - `total_hours`: sum of the duration of all finished sessions.

  The method responds with a JSON summary. If no tasks or sessions exist, it returns zero values.
  If `user_id` is missing, it responds with 400. If a database error occurs, it logs the failure and returns 500.

```
def main(req: func.HttpRequest) -> func.HttpResponse:
    logging.info(f"Stats function invoked. Method={req.method}")

    if req.method != "GET":
        return _json_response({"error": f"Method {req.method} not allowed"}, 405)

    user_id = req.route_params.get("user_id") or req.params.get("user_id")
    if not user_id:
        return _json_response({"error": "user_id is required in route or query"},
400)

    try:
        stats = stats_service.get_user_stats(user_id)
        return _json_response(stats, 200)

    except DatabaseError as e:
        logging.exception("Database error while generating stats")
        return _json_response({"error": str(e)}, 500)
    except Exception as e:
        logging.exception("Unexpected error in stats function")
        return _json_response({"error": "Internal server error", "detail":
str(e)}, 500)
```

Tasks Endpoint

The **Tasks** endpoint handles the creation and management of user tasks.
Tasks represent the smallest measurable unit of productivity and are the foundation of the gamified workflow.
This endpoint ensures users can easily record their daily goals and track progress.

- **POST /api/tasks**
  Create a new task for a user.
  The method first validates the request payload: it must contain a non-empty `title` and a `user_id`, since Cosmos DB requires partitioning by user.
  If valid, it instantiates a new `Task` entity, adds the `user_id`, and persists it through the repository.
  In case of invalid input, a 400 error is returned; if the database layer fails, the error is logged and a 500 response is returned. It delegates to `task_service.create_task(user_id, title)`

```python
def main(req: func.HttpRequest) -> func.HttpResponse:

    # rest of the method

    if req.method == "POST":
        # Create a new task
        try:
            data = req.get_json()
        except ValueError:
            return _json_response({"error": "Invalid JSON payload"}, 400)

        title = (data.get("title") or "").strip()
        user_id = data.get("user_id")

        try:
            created = task_service.create_task(user_id, title)
            return _json_response(created, 201)
        except ValueError as ve:
            return _json_response({"error": str(ve)}, 400)
        except DatabaseError as e:
            logging.exception("Database error while creating task")
            return _json_response({"error": str(e)}, 500)
```

- **GET /api/tasks?user_id=...**
  Retrieve tasks, optionally filtered by a specific user.
  The endpoint delegates directly to `TaskService.list_tasks(user_id)`, which decides whether to call `TaskRepository.list_tasks()` (all tasks) or `TaskRepository.list_tasks_by_user(user_id)` (filtered).
  This keeps the endpoint thin and ensures all query logic remains encapsulated in the repository layer, respecting the service–repository separation.
  Any `DatabaseError` raised is caught, logged, and returned as a `500 Internal Server Error`.

```
def main(req: func.HttpRequest) -> func.HttpResponse:

    # rest of the method

    if req.method == "GET":
        # List tasks, optionally filtered by user_id
        user_id = req.params.get("user_id")
        try:
            items = task_service.list_tasks(user_id)
            return _json_response(items, 200)
        except DatabaseError as e:
            logging.exception("Database error while listing tasks")
            return _json_response({"error": str(e)}, 500)
```

- **PATCH /api/tasks/{id}**
  Update an existing task, most commonly to mark it as `completed`.
  The method extracts the task `id` from the route parameters and optionally accepts an action from the request body (default: `"complete"`).
  If the action is `"complete"`, it delegates to `TaskService.complete_task(task_id)`, which performs the update and persists the change through the repository.
  Errors are handled carefully: if the database indicates the task was not found, the endpoint returns **404**; other database errors result in **500**.
  If an unsupported action is provided, the endpoint explicitly returns **400** with a descriptive error message.

```
def main(req: func.HttpRequest) -> func.HttpResponse:

    # rest of the method

    if req.method == "PATCH":
        # Partial update — used to mark a task as completed.
        task_id = req.route_params.get("id") or req.params.get("id")
        if not task_id:
            return _json_response(
                {"error": "Task id is required in route (tasks/{id})"}, 400
            )

        try:
            updated = task_service.complete_task(task_id)
            return _json_response(updated, 200)
        except DatabaseError as e:
            msg = str(e)
            logging.exception(f"Error completing task {task_id}")
            if "not found" in msg.lower():
                return _json_response({"error": msg}, 404)
            return _json_response({"error": msg}, 500)
```

WorkSessions Endpoint

The **WorkSessions** endpoint manages productive work sessions for users.
A work session represents a block of focused time linked to a specific user, with automatic tracking of start, end, and total duration.
This endpoint ensures users can track their working habits, close active sessions properly, and analyze their productivity later.
It is powered by the `WorkSessionService`, which encapsulate business logic.

- **POST /api/work_sessions**
  Manage work sessions for a user. This endpoint supports two actions: starting a new session or ending an existing one.
  - **Start a session** (`POST /work_sessions/start`)
    Requires a `user_id` in the request body. The endpoint validates the input and checks if an active session already exists for the user.
    If no active session exists, it delegates to `WorkSessionService.start_session(user_id)`, which creates a new `WorkSession` entity with the current UTC timestamp as `start_time` and persists it.
    If `user_id` is missing, the function responds with **400**; if an active session already exists, it responds with **400**; if database persistence fails, it logs the error and returns **500**.
    On success, the response includes the session's metadata (UUID, start time).
  - **End a session** (`POST /work_sessions/{id}/end`)
    Expects the session `id` in the route. The endpoint calls `WorkSessionService.end_session(session_id)`, which updates the session by setting its `end_time`.
    If the session is not found, it responds with **404**; for other database errors, it responds with **500**.

```
def main(req: func.HttpRequest) -> func.HttpResponse:

# rest of the method

# --- Start session ---
    if req.method == "POST" and route == "start":
        try:
            data = req.get_json()
        except ValueError:
            return _json_response({"error": "Invalid JSON payload"}, 400)

        user_id = data.get("user_id")
        if not user_id:
            return _json_response({"error": "Field 'user_id' is required"}, 400)

        # Ensure no active session exists
        active = ws_service.get_active_session(user_id)
        if active:
            return _json_response({"error": "Active session already exists"},
400)

        try:
            session = ws_service.start_session(user_id)
            return _json_response(session, 201)
        except DatabaseError as e:
            logging.exception("Database error while starting session")
            return _json_response({"error": str(e)}, 500)

    # --- End session ---
    elif req.method == "POST" and route:
        session_id = route
        try:
            ended = ws_service.end_session(session_id)
            return _json_response(ended, 200)
        except DatabaseError as e:
            msg = str(e)
            logging.exception(f"Error ending session {session_id}")
            if "not found" in msg.lower():
                return _json_response({"error": msg}, 404)
            return _json_response({"error": msg}, 500)
```

- **GET /work_sessions/active**
  Retrieve the currently active work session for a given user.
  Requires `user_id` as a query parameter, since sessions are always tied to a user.
  The endpoint delegates to `WorkSessionService.get_active_session(user_id)`, which queries Cosmos DB for any `work_session` document where `end_time` is `NULL`.
  If an active session exists, it is returned; otherwise, the endpoint responds with `{"active": False}`.
  If the `user_id` parameter is missing, the function responds with **400**.
  If a database error occurs, it logs the failure and returns **500**.

```
def main(req: func.HttpRequest) -> func.HttpResponse:

# rest of the method

# --- Get active session ---
if req.method == "GET" and route == "active":
    user_id = req.params.get("user_id")
    if not user_id:
        return _json_response({"error": "Query parameter 'user_id' is required"},
400)

    try:
        active = ws_service.get_active_session(user_id)
        if active:
            return _json_response(active, 200)
        else:
            return _json_response({"active": False}, 200)
    except DatabaseError as e:
        logging.exception("Database error while checking active session")
        return _json_response({"error": str(e)}, 500)

else:
    return _json_response({"error": f"Method {req.method} with route not
supported"}, 405)
```

1.2 Azure Functions Testing

Before deploying to Azure, it's essential to validate the structure and behavior of our Azure Functions locally. This section outlines the testing setup used in the project, including centralized function routing via the Python v2 programming model, environment configuration, and secure credential management. By replicating the Azure Functions runtime locally, we ensure that all endpoints behave as expected and that external dependencies—such as Cosmos DB—are properly initialized prior to production deployment.

To start the local runtime, use the following command:

```
func start

# for verbose error output
func start --verbose
```

1.2.1 `function_app.py`: central endpoint manager

In order to test the project before deploying it to Azure Functions we will need a new file named `function_app.py`. This is due to the fact that Azure functions can only read files one level under the root directory, so we will need to centralize all the project endpoints in a single file that will reference them:

```
# function_app.py
import azure.functions as func
from work.work_sessions import main as work_sessions_main
from work.tasks import main as tasks_main
from work.stats import main as stats_main

app = func.FunctionApp()

@app.function_name(name="WorkSessions")
@app.route(route="work_sessions/{*route}", methods=["GET", "POST"])
def work_sessions(req: func.HttpRequest) -> func.HttpResponse:
    return work_sessions_main(req)

@app.function_name(name="Tasks")
@app.route(route="tasks/{id?}", methods=["GET", "POST", "PATCH"])
def tasks(req: func.HttpRequest) -> func.HttpResponse:
    return tasks_main(req)

@app.function_name(name="Stats")
@app.route(route="stats/{user_id}", methods=["GET"])
def stats(req: func.HttpRequest) -> func.HttpResponse:
    return stats_main(req)
```

This code is from the **first phase** of the proyect, so it only includes 3 endpoints.

1.2.2 Virtual environment

To avoid conflicts, we will create a virtual environment exclusively for this testing environment, as it is mandatory for Azure to use **Python 3.10** as python 3.11 is not supported yet. For this, we will use the following commands (Linux):

```
python -m venv azfunc310
source azfunc310/bin/activate  # or .\azfunc310\Scripts\activate on Windows
```

After that, we need the dependencies:

```
pip install -r requirements.txt
```

Make sure `requirements.txt` includes the following packages:

```
azure-functions
python-dotenv
azure-cosmos
```

1.2.3 Enviroment Variables

and the `.env` file that will manage all the credentials in `_shared/credential_manager.py`

```
# ======================
#   Resource group name
# ======================

RESOURCE_GROUP=avanochi-rg
LOCATION=eastus

# ======================
#       Cosmos DB
# ======================

COSMOS_DB_ACCOUNT=avanochi-cosmosdb
COSMOS_DB_DATABASE=avanochi-db
COSMOS_DB_CONTAINER=avanochi-container

COSMOS_DB_URI=https://avanochi-cosmosdb.documents.azure.com:443/
COSMOS_DB_PRIMARY_KEY=[SECRET]
```

1.2.4 Final testing

After doing all the previous configuration, testing in the local enviroment should work out perfectly,

```
(base) mike@AVAPC-083306703:/mnt/c/Users/mike.maranon/Desktop/codes/AVANOCHI$ cd
avanochi/azure/AZ_functions/
(base) mike@AVAPC-
083306703:/mnt/c/Users/mike.maranon/Desktop/codes/AVANOCHI/avanochi/azure/AZ_functions$
conda activate azfunc310
(azfunc310) mike@AVAPC-
083306703:/mnt/c/Users/mike.maranon/Desktop/codes/AVANOCHI/avanochi/azure/AZ_functions$
func start
```

giving us the following output:

```
Found Python version 3.10.18 (python3).
You are running a preview version of Azure Functions Core Tools.


Azure Functions Core Tools
Core Tools Version:       4.3.0-preview1+364f397008ae6956181a0f9fb738ef20924ac389 (64-
bit)
Function Runtime Version: 4.1041.200.25360

[2025-09-30T13:15:14.524Z] Worker process started and initialized.

Functions:

        Stats: [GET] http://localhost:7071/api/stats/{user_id}

        Tasks: [GET,POST,PATCH] http://localhost:7071/api/tasks/{id?}

        WorkSessions: [GET,POST] http://localhost:7071/api/work_sessions/{*route}

For detailed output, run func with --verbose flag.
[2025-09-30T13:15:16.081Z] Host lock lease acquired by instance ID
'0000000000000000000000003E9803A7'.
```

As we can see, we have the three exposed endpoints with their required input data such as `{user_id}` for `stats`