ALMA MATER STUDIORUM – UNIVERSITÀ DI BOLOGNA

Corso di Laurea in Ingegneria e Scienze Informatiche

Sviluppo di un pannello Web a supporto di un filtro DNS

Tesi di laurea in:
Programmazione ad Oggetti

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Sommario

Questa tesi descrive la progettazione, lo sviluppo e l'analisi architetturale di una applicazione web full-stack, realizzata in collaborazione con l'azienda FlashStart Group. Il progetto nasce dalla necessità di fornire una dashboard in sola lettura per la visualizzazione e l'analisi dei dati provenienti dal servizio di filtraggio DNS offerto ai clienti dell'azienda.

L'obiettivo del lavoro è duplice: da un lato, la realizzazione di una piattaforma software funzionale, sicura e manutenibile; dall'altro, l'analisi critica delle scelte architetturali e dei design pattern della programmazione orientata agli oggetti (OOP) che ne hanno guidato lo sviluppo.

La metodologia si basa su un'architettura a servizi containerizzata con Docker. Il backend è stato sviluppato in Java, adottando il paradigma di programmazione reattiva con Spring WebFlux per garantire scalabilità ed efficienza. Il frontend è un'applicazione single-page (SPA) costruita con React e TypeScript. La gestione dei dati è affidata a un database PostgreSQL, mentre la sicurezza è implementata tramite un sistema di autenticazione basato su token JWT con rotazione.

Il risultato è un'applicazione capace di interfacciarsi con gli endpoint esterni di FlashStart e di presentare i dati in modo intuitivo attraverso componenti grafici. La trattazione approfondisce l'applicazione pratica di design pattern fondamentali come il Factory Method, utilizzato per la creazione di filtri dinamici nel gateway, e analizza come i principi SOLID e le tecniche OOP siano stati il fondamento per la strutturazione dei componenti sia del backend che del frontend.

Questo lavoro rappresenta un'analisi di come i principi teorici dell'ingegneria del software e i pattern OOP trovino applicazione concreta per risolvere problemi industriali, evidenziando benefici e compromessi delle scelte implementative in un contesto aziendale reale.

Indice

Capitolo 1

Introduzione

1.1 Contesto Aziendale e Motivazione del Progetto

Il presente lavoro di tesi si inserisce in un contesto industriale specifico, frutto della collaborazione con FlashStart SRL, un'azienda italiana con sede a Cesena, specializzata nello sviluppo e nella fornitura di soluzioni di filtraggio dei contenuti e protezione da minacce informatiche basate su tecnologia DNS (Domain Name System). I servizi offerti da FlashStart si rivolgono a una clientela diversificata, che include aziende, istituzioni educative e pubbliche amministrazioni, fornendo loro strumenti per garantire una navigazione sicura e controllata.

Al momento dell'inizio del percorso di tirocinio, nel mese di giugno 2025, l'azienda si trovava in una fase di significativa evoluzione tecnologica e strategica. Era infatti in corso un processo di completa reingegnerizzazione della propria piattaforma di gestione, la dashboard utilizzata dai clienti per configurare e monitorare il servizio di filtraggio. Questo processo, unito a un'operazione di rebranding aziendale, mirava a modernizzare l'infrastruttura e l'esperienza utente, con un rilascio previsto per novembre 2025.

In questo scenario di transizione, è emersa una criticità tanto specifica quanto urgente. La piattaforma allora in uso, pur essendo efficace per la gestione delle policy di protezione, presentava una notevole lacuna funzionale: l'assenza di una modalità di consultazione dei dati in sola lettura (readonly). Gli utenti, in par-

ticolare gli amministratori di rete e i responsabili IT, manifestavano la crescente necessità di poter analizzare i report e le statistiche di navigazione senza avere i permessi di modifica, per evitare alterazioni accidentali delle configurazioni di sicurezza.

Il progetto di tesi nasce per rispondere a questa precisa esigenza. Data l'impossibilità di attendere il rilascio della nuova piattaforma, si è optato per lo sviluppo di una soluzione tattica e mirata: un'applicazione web temporanea, concepita come "ponte" (bridge) tecnologico. Lo scopo primario di questa applicazione è fornire ai clienti un pannello di controllo readonly per le funzionalità standard di analisi dei dati, garantendo continuità operativa e soddisfacendo le richieste del mercato fino alla migrazione sulla nuova infrastruttura. Questo lavoro di tesi documenta pertanto non solo la realizzazione di un prodotto software, ma anche l'approccio ingegneristico adottato per sviluppare una soluzione efficace e affidabile in un contesto agile e con vincoli temporali definiti.

1.2 Panoramica dello Stack Tecnologico

La realizzazione di un'applicazione robusta, scalabile e sicura, pur in un contesto di sviluppo agile e a breve termine, ha richiesto un'attenta selezione delle tecnologie costitutive. L'architettura del sistema è stata progettata per essere moderna e reattiva, garantendo un'esperienza utente fluida e un uso efficiente delle risorse server. Ogni componente dello stack, dal backend al frontend, fino all'infrastruttura di deployment, è stato scelto per rispondere a precise esigenze di progetto.

Il cuore pulsante dell'applicazione risiede nel backend, sviluppato in Java 17 e fondato sul framework Spring Boot. Per questo progetto è stato adottato un paradigma di programmazione completamente reattivo, utilizzando Spring WebFlux anziché il tradizionale Spring MVC. Questa scelta strategica si basa sulla natura dell'applicazione, intrinsecamente legata a operazioni di I/O (input/output) come le chiamate verso API esterne e l'accesso al database. Il modello non bloccante di WebFlux permette di gestire un elevato numero di connessioni concorrenti con un numero limitato di thread, ottimizzando le risorse e garantendo bassa latenza. Inoltre, il backend assume un ruolo centrale di API Gateway grazie all'integrazione con Spring Cloud Gateway. Questa componente orchestra il traffico di rete,

indirizzando le richieste del client verso le API interne dell'applicazione o fungendo da proxy sicuro verso i due distinti endpoint di FlashStart, applicando filtri personalizzati per l'autenticazione e l'arricchimento delle chiamate.

Per l'interfaccia utente è stata realizzata una Single Page Application (SPA) utilizzando React, una delle librerie JavaScript più diffuse per la creazione di interfacce complesse e performanti. L'adozione di TypeScript ha introdotto la tipizzazione statica nel codice frontend, un elemento cruciale per aumentare la robustezza, la manutenibilità e la chiarezza del codice, riducendo la probabilità di errori a runtime. La comunicazione asincrona con il backend avviene tramite chiamate HTTP gestite dalla libreria axios, configurata con intercettori specifici per aggiungere automaticamente i token di autenticazione alle richieste e per gestire in modo trasparente la logica di rinnovo dei token in caso di sessione scaduta, come definito in axiosInstance.ts.

La persistenza dei dati, limitata alle informazioni su utenti e token per la gestione delle sessioni, è affidata a PostgreSQL, un database relazionale open-source rinomato per la sua stabilità e le sue funzionalità avanzate. Per mantenere la coerenza con l'approccio reattivo del backend, l'accesso al database è gestito tramite Spring Data R2DBC (Reactive Relational Database Connectivity). Questo permette di estendere il paradigma non bloccante fino al livello di accesso ai dati, evitando colli di bottiglia e garantendo che l'intera catena di elaborazione di una richiesta, dalla ricezione alla risposta, rimanga asincrona.

La sicurezza dell'applicazione è un pilastro fondamentale dell'architettura. Il sistema di autenticazione è stateless e si basa su JSON Web Tokens (JWT), che vengono trasmessi dal client nell'header di ogni richiesta autorizzativa. Per mitigare i rischi legati a token di lunga durata, è stato implementato un meccanismo di sicurezza avanzato noto come rotazione dei refresh token. Come visibile nel AuthenticationService, ogni volta che un refresh token viene utilizzato con successo per ottenere un nuovo access token, esso viene immediatamente invalidato e sostituito da uno nuovo. Questa strategia riduce drasticamente la finestra temporale in cui un token compromesso potrebbe essere sfruttato, aumentando significativamente la sicurezza complessiva delle sessioni utente.

Infine, l'intera infrastruttura è gestita tramite un approccio DevOps moderno. L'applicazione è interamente containerizzata utilizzando Docker, e la sua architet-

tura multi-servizio (backend, frontend web server e database) è definita tramite file docker-compose.yaml. Questo garantisce la portabilità e la riproducibilità dell'ambiente su macchine diverse. Il ciclo di vita dello sviluppo è automatizzato da una pipeline di Continuous Integration e Continuous Deployment (CI/CD) ibrida, che si avvale di GitHub Actions per l'orchestrazione dei flussi di lavoro e di un runner self-hosted, installato direttamente sul server di destinazione, per eseguire in modo sicuro le operazioni di build e deployment.

Capitolo 2

Background

Capitolo 3

Analisi

Capitolo 4

Design

Capitolo 5

Implementazione

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