DevOps Technical Documentation

VocabVersus

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# Introduction

This document contains VocabVersus’ development and deployment set-up/architecture.

As the VocabVersus project is currently limited to a small-scale school project, the goal of the DevOps architecture will be to reduce costs as much as possible without limiting functionality.

The VocabVersus pipelines are set-up to host the codebase in [GitHub](#_Code-Base_Management) for version control, making use of [GitHub Actions](#_Github_Actions) for performing the CI/CD Pipeline and building the application to [Docker images](#_Docker) which are stored in [Docker Hub repositories](#_Docker_Hub) and deployed to [Azure App Services](#_Azure_App_Services).

All sensitive information such as authentication details are stored in [GitHub secrets](https://docs.github.com/en/actions/security-guides/encrypted-secrets) which are accessible from within GitHub Actions.

A picture containing diagram

Description automatically generated

# Codebase Management

VocabVersus uses [GitHub](https://github.com/) (a [Git](https://git-scm.com/) based) version management tool, here multiple public repositories are used to host the codebase, the head [VocabVersus](https://github.com/Thomas-Molen/VocabVersus) repository contains submodule references to all separate service repositories.

GitHub offers [unlimited free public and private repositories](https://github.com/pricing) with limited collaboration features, this allows VocabVersus’ codebase (as a single developer project) to be hosted for free on GitHub, compared to other hosts such as [Fontys GitLab](https://projects.fhict.nl/users/sign_in) which require self-hosted runners for CI/CD.

# CI/CD

The VocabVersus project has CI/CD pipelines for all service repositories; these pipelines perform automated tests, build the application and are capable of automatically deploying new versions.

## GitHub Actions

As the VocabVersus projects are managed within GitHub, [GitHub Actions](https://github.com/features/actions) are used to perform CI/CD pipelines.

GitHub Actions are used to test, build and deploy the VocabVersus services automatically on specified triggers (such as pushing to specified branches).

GitHub provides [free runners for performing GitHub Actions](https://docs.github.com/en/billing/managing-billing-for-github-actions/about-billing-for-github-actions), with a limitation of 2000 execution minutes per month (when run in a Linux Environment, other operating systems are more limited) and 500MB of limited storage. This allows the VocabVersus CI/CD Testing, building and deployment to be hosted for free with GitHub Actions.

## Docker

The VocabVersus services are built as [Docker images](https://www.techtarget.com/searchitoperations/definition/Docker-image), this allows the application to be run as [containers](https://www.docker.com/resources/what-container/#:~:text=A%20Docker%20container%20image%20is,tools%2C%20system%20libraries%20and%20settings.) on a wide range of systems, allowing for significant freedom in hosting options due to its provided system compatibility.

### Docker Hub

[Docker Hub](https://hub.docker.com/) is a docker image management tool used to store docker images in repositories, here VocabVersus images built during the CI/CD pipeline are stored and served on demand to servers hosting the application.

Docker Hub allows for docker images to be [stored for free](https://www.docker.com/pricing/) in public repositories (or 1 private repository) allowing VocabVersus to host all service images to be stored for free in public repositories. Other image repositories such as [Azure Container Registry](https://azure.microsoft.com/en-us/products/container-registry) can also be used for free with a student subscription and would allow for better integration with image hosts such as Azure App Services, it was decided however to use Docker Hub as it is always free even without a student subscription.

# Cloud Deployment

The VocabVersus project is based on several different services (such as the game interface, game engine and word evaluator), these services are hosted and served from the cloud to users, leveraging the reliability and scalability offered by using large cloud providers such as [AWS](https://aws.amazon.com/free/?trk=364c4e1b-8820-40b1-b480-185cfc1d34b6&sc_channel=ps&ef_id=Cj0KCQjw9deiBhC1ARIsAHLjR2CTDkghy_kJweAtKtkH55aEzG2Ggqoz2b4CVMq-YuegrQ1mN7dS9Z4aAk8VEALw_wcB:G:s&s_kwcid=AL!4422!3!458573551165!e!!g!!aws!10908848156!107577274055&all-free-tier.sort-by=item.additionalFields.SortRank&all-free-tier.sort-order=asc&awsf.Free%20Tier%20Types=*all&awsf.Free%20Tier%20Categories=*all), [Azure](https://azure.microsoft.com/en-us/free/search/?ef_id=_k_Cj0KCQjw9deiBhC1ARIsAHLjR2AOua8MYmaCUlkwzmuqDw_hrR_Nm8w3dcG35K6fFP0pBN8Os27xAuYaAmwrEALw_wcB_k_&OCID=AIDcmmy4pl1olr_SEM__k_Cj0KCQjw9deiBhC1ARIsAHLjR2AOua8MYmaCUlkwzmuqDw_hrR_Nm8w3dcG35K6fFP0pBN8Os27xAuYaAmwrEALw_wcB_k_&gclid=Cj0KCQjw9deiBhC1ARIsAHLjR2AOua8MYmaCUlkwzmuqDw_hrR_Nm8w3dcG35K6fFP0pBN8Os27xAuYaAmwrEALw_wcB) or [Digital Ocean](https://www.digitalocean.com/?refcode=e8a7842ff717).

## Azure App Services

All VocabVersus docker images are hosted in [Azure App Services](https://azure.microsoft.com/en-us/products/app-service/), these app services allow for fast` deployment of web applications and support several options for future scalability with features such as: Parallel instance hosting, which provides seamless hosting of the same service in multiple locations and staged versioning to reduce downtime, as well as classic horizontal scaling by increasing the provided hardware for a single service.

Azure provides a [free app service pool](https://azure.microsoft.com/en-us/pricing/details/app-service/linux/) that allows for 10 individual apps to be hosted concurrently, with a networked disk volume of 1GB (similar to [docker storage volumes](https://docs.docker.com/storage/volumes/)), which allows for all VocabVersus services to be hosted in an app service pool as docker containers alongside storing the word evaluator data in the 1GB disk volume.

Azure also provides extremely specialized hosting services such as [azure functions](https://azure.microsoft.com/en-us/products/functions/?ef_id=_k_Cj0KCQjw9deiBhC1ARIsAHLjR2C9f1NICH9FxJI_bsF3gwdeFdMdlt0DKjm5TSZp3evV-yYo6TI95ekaAvrnEALw_wcB_k_&OCID=AIDcmmy4pl1olr_SEM__k_Cj0KCQjw9deiBhC1ARIsAHLjR2C9f1NICH9FxJI_bsF3gwdeFdMdlt0DKjm5TSZp3evV-yYo6TI95ekaAvrnEALw_wcB_k_&gclid=Cj0KCQjw9deiBhC1ARIsAHLjR2C9f1NICH9FxJI_bsF3gwdeFdMdlt0DKjm5TSZp3evV-yYo6TI95ekaAvrnEALw_wcB) which could be used for lightweight serverless logic to be executed alongside [SignalR Service](https://azure.microsoft.com/en-us/products/signalr-service/) which provides a minimized instance of SignalR to be used for communication for example between a user and azure functions.

Due to the [limited concurrent connections](https://azure.microsoft.com/en-us/pricing/details/signalr-service/) allowed for the free tier of SignalR Service, it was decided not to utilize this cloud service for the VocabVersus engine (which uses SignalR for fast bi-directional communication) but could provide a good solution for a larger scale project with a higher budget.

### Pipeline integration

The final step of the CI/CD Pipeline is to deploy the built docker images to the azure app services, this is achieved by requesting the relevant app services to fetch the newly stored image from Docker Hub and re-serve that version of the image on the server.

To send these requests to the app service, the pipeline will first need to authenticate itself as a user with proper permissions to perform such actions. Sadly, due to the Azure account being connected to the FHICT domain, no extra users with limited permissions can be created and thus the admin account’s publish profile is used.