Extra: Containers

Assignment description

This task has two main objectives, the first one is to familiarize yourself with containerization (using Docker) and the running of containerized, interconnected services. After being familiar with containers, the second task is to host the same system using Kubernetes for orchestrating the containers. This adds scalability by using deployed services.

It is strongly recommended to do this assignment on your main Linux (i.e. not on a virtual machine) because running Docker and Kubernetes on a VM results in nested virtualization, which VirtualBox has limited support for. If you want to do the assignment on a virtual machine, VMWare Workstation Player is a free software that allows running Docker inside your VM.

1. Preparation

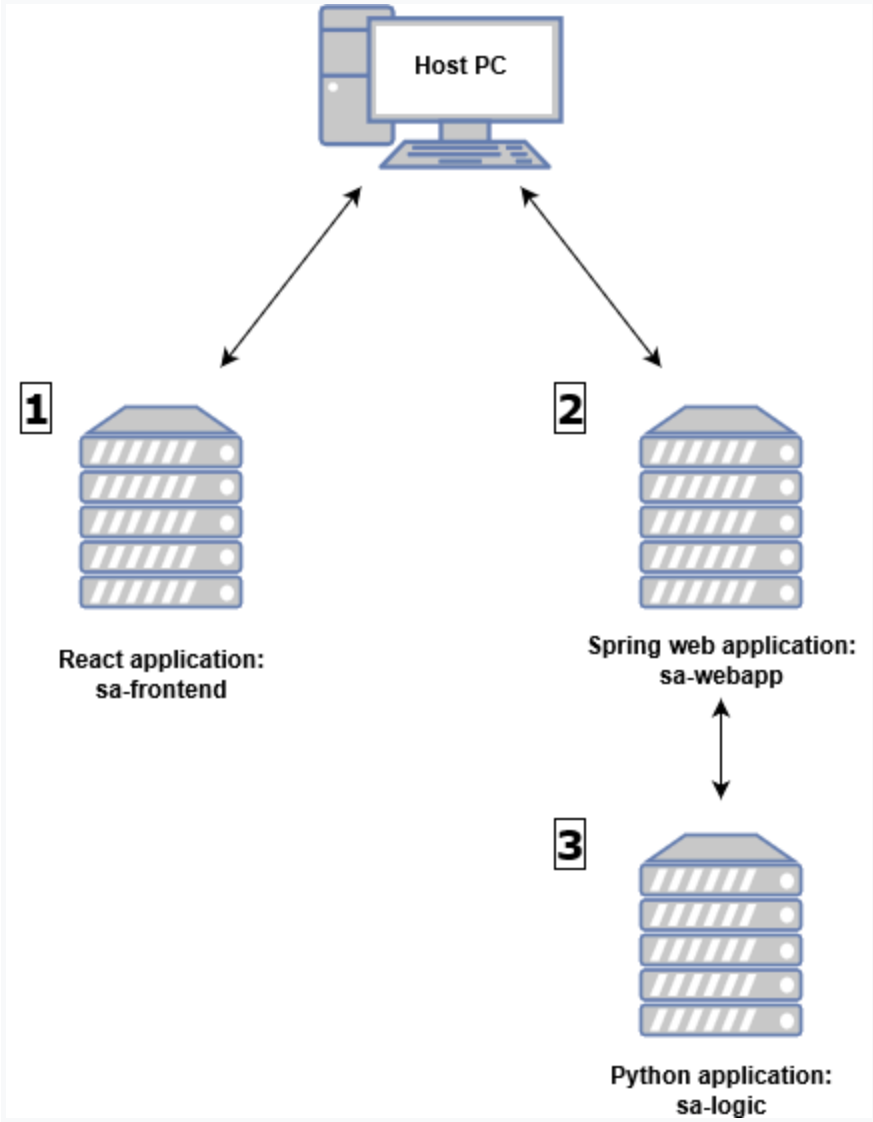
You can download the files needed for the assignment at:
https://version.aalto.fi/gitlab/illahig1/containers.git

Then, install Docker and create a user to Docker Hub. This is necessary because you will be building and pushing images there.

1.1	Show your Docker Hub for this assignment's containers.	1p
1.2	How can you use one Docker repository to hold multiple containers?	1p

2. Docker

You will host three services on different Docker containers: a react webpage, which is the frontend of the website; a spring web application, which contacts a python application and returns the results in json format; and a python application containing the website logic. Due to this architecture, you will need to build the website in reverse order, as the spring application will need to know the IP address of the Python application, and the webpage will need to know the Spring application's IP. To test out the Docker installation however, you will first build the frontend of the website. Then build the other services and change the webpage to point to the right address.



1 Go to sa-frontend folder in the files. Before you can build your first Docker image, you need to build the webpage. To do this, you need to install npm. After installing npm, run “npm install” to download the required scripts, and run “npm run build” to build the webpage. After building the webpage, build a Docker image by using the Dockerfile. Push the created image to your Docker hub. Finally, run the created image in a Docker container, and configure it so that port 3000 on localhost points to port 3000 on the container.

Hint: You might want to configure what port nginx uses.

2 Check that you can access the website frontpage on http://localhost:3000 using a web browser. The button doesn’t work yet, as the software logic isn’t running.

3 Go to sa-logic folder, and build the Docker image using the Docker file. Push the image to your hub, and run the application, listening on port 5050 of the host and 5000 of the container.

4 To be able to build the webapp-image, you will need to install jdk and maven. After installing them, go to sa-webapp folder and run the command mvn install. It will create a new directory called target. After this, find the IP address of the running logic-container, and edit the Dockerfile, so that the IP points to that service. You also need to edit the ADD and CMD -lines so that they point to the correct .jar file in target directory. Build the docker image, push it to your hub, and run the application, listening on port 8080 of both host and the container.

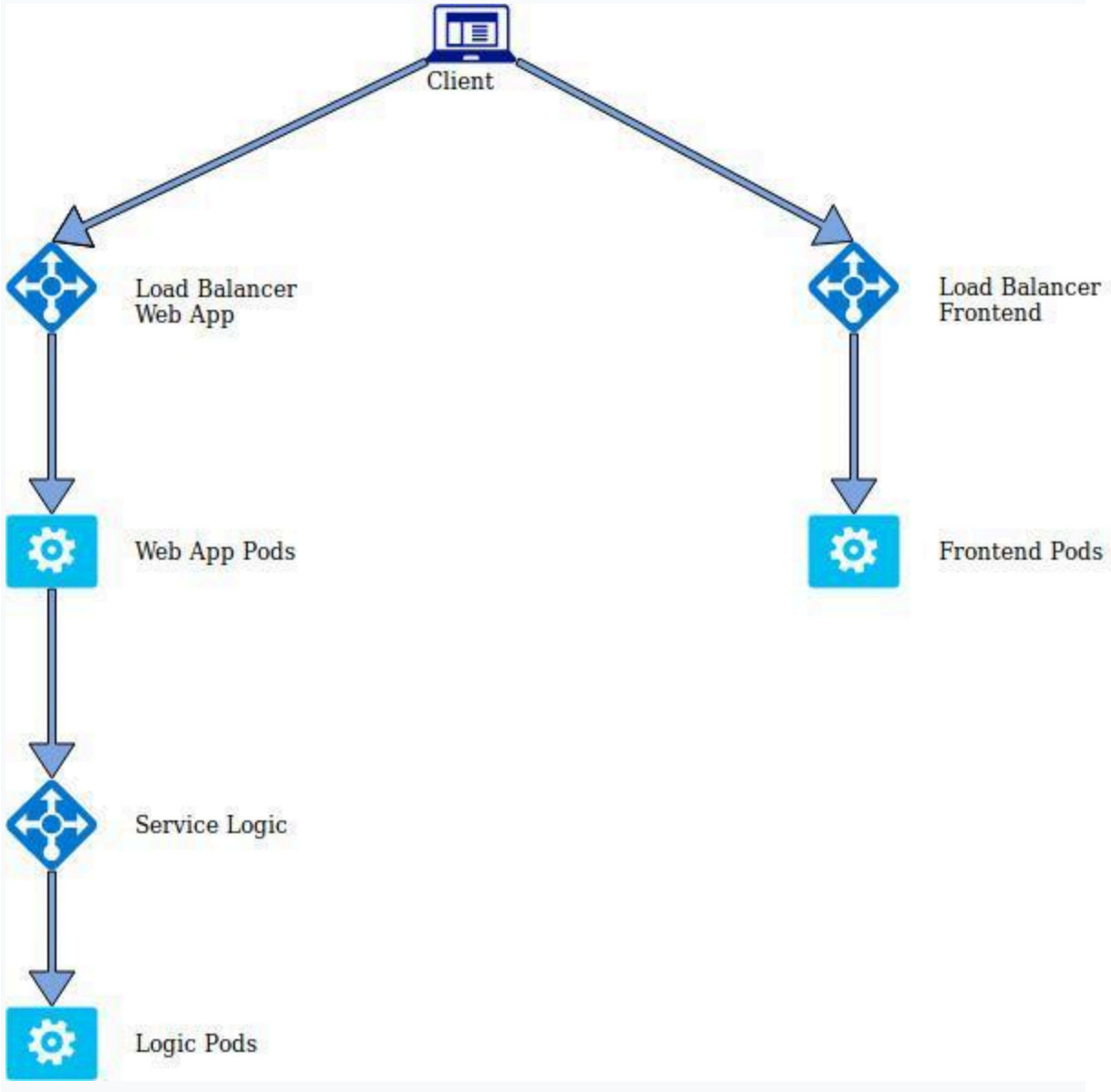
5 Now you need to change the sa-frontend/src/App.js -file to fetch data from the webapp container. Edit the analyzeSentence() -function. Before building the Docker image, you will need to build the webpage again. Afterwards, build the Docker image, push it to your hub and run the application.

6 The website should now work on your browser. Go to http://localhost:3000 and type a phrase to see the sentiment you get. If the website doesn't work, try clearing your browser cache of any previous versions it may have stored.

2.1	List the commands you used for building, pushing and running the containers	2p
2.2	Show the IP of one of the running containers	1p
2.3	Demonstrate that the website is running and functional	3p
2.4	Explain your changes to the Dockerfiles	2p

3. Kubernetes

Now you will add scalability to your service by using load balancers and deployments. In Kubernetes, deployments can be used to create a replica-set of a service, allowing for scaling of the service for your needs. A load balancer will forward your request to one of the replicas, which will deliver the service. The resulting service topology will look like this:



1 This section requires you to install Minikube for running a Kubernetes cluster, as well as kubectl, a client tool for accessing the cluster. Install them and start Minikube.

2 Go to resource-manifest directory, and create a Kubernetes pod using sa-frontend-pod.yaml. Edit the yaml-file to use the frontend container image from your Docker hub. Set port-forwarding so that you can access the pod's port 80 on localhost port 88. Make sure you can see the webpage.

3 To add scalability to your website, create another frontend pod from sa-frontend-pod2.yaml. Use the container image from your hub. Check that the

new pod is running. This is not the best way to provide scalability, but it will be improved in further steps.

4 You will now add a load balancer service to direct traffic to one of the front pages. The load balancer recognizes the pods by the label “app: sa-frontend”. Make sure both pods have that label. Then run the service using service-sa-frontend-lb.yaml. Check that the service is running. Don’t worry if the IP stays in pending; it is because you are using minikube and not a cloud service. You need to locally solve this issue, so that you can access it by using the web browser.

5 At this point the load balancer is recognizing the pods based on a label. That fulfills the requirements for a scaled application. Now you need to run two replicas of the frontend -pod using a deployment. You can do it by using sa-frontend-deployment.yaml. Once again, you need to edit the file to use your own container image. After you have the deployment running, remove the two pods created in the previous steps using kubectl delete.

6 Now it’s time to deploy the other services. Start by deploying logic. Edit the yaml file to use your own container. Remember to apply the logic service as well as the deployment. After this, verify that the service and pods are running.

7 Finally, you need to deploy the webapp service and load balancer. Note that the yaml-file has defined the environment variable pointing to the logic service URL, so you don’t need to change that. Change the file to use your container image, though. After the edits, start the deployment and the load balancer.

8 Note that you must change the frontend App.js to point to the right address again. Use the IP of the webapp load balancer. You can get it by using “minikube service list”. After making the changes, use npm to build the webpage, build the docker image, and upload it to Docker Hub. Then reapply the deployment. The website should now be accessible and working through the frontend load balancer service.

3.1	List the commands you used for running the services, pods and deployments	2p
3.2	Demonstrate the website is running by connecting to the frontend load balancer. How does this differ from connecting to one of the pods?	3p

3.3	Explain the contents of sa-frontend-deployment.yaml, including what changes you made	2p
3.4	How can you scale a deployment after it has been deployed?	1p