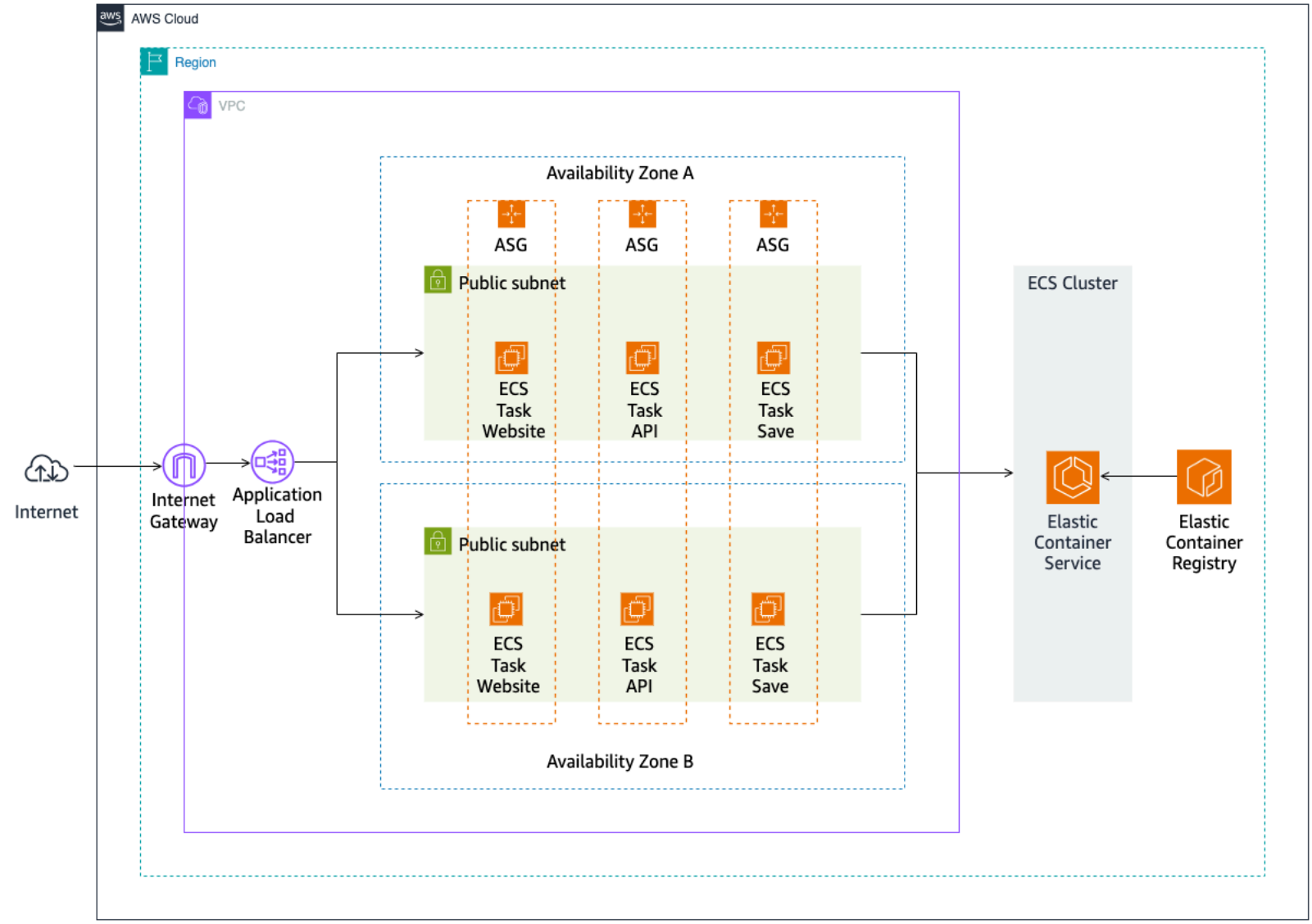
Building and Deploying Containers Using Amazon Elastic Container Service

This report details the execution and commands used for building, pushing, and deploying a three-tier containerized application (Website, API, and Save services) using Amazon Elastic Container Service (ECS) and Elastic Container Registry (ECR).



Phase 1: Containerization and Local Testing

I started by building the Docker images for all three services (Website, API, Save).

1. Website Service (storyizer/website)

The website container uses Apache HTTPD to serve the front-end application. I dynamically injected the **Application Load Balancer (ALB) DNS name** into the container during the build process using a build argument.

Website Dockerfile (WebSite/Dockerfile)

```
cat Dockerfile
FROM rockylinux/rockylinux

ARG ELBDNS
ENV ServerName=Storyizer-site ELBDNS=${ELBDNS}

RUN yum -y update && \
    yum -y install httpd unzip && \
    yum clean all

# Install app
COPY ./code/ /var/www/html/

# Config App
RUN echo "ServerName storyizer.training " >> /etc/httpd/conf/httpd.conf \
  && sed -i -- "s|APIELB|$ELBDNS|g" /var/www/html/js/env.js \
  && sed -i -- "s|SaveELB|$ELBDNS|g" /var/www/html/js/env.js

EXPOSE 80

ENTRYPOINT ["/usr/sbin/httpd", "-D", "FOREGROUND"]
```

Commands Executed for Website Build and Test:

Step	Command Executed	Purpose
Navigate	cd WebSite	Enter the website source

		directory.
Get ALB DNS	`export ALB_DNS_NAME=$(aws elbv2 describe-load-balancers --names StoryizerAELB	jq -r '.LoadBalancers[0].DNSName')`
Build Image	docker build -t storyizer/website --build-arg ELBDNS=$ALB_DNS_NAME .	Build the image, passing the ALB DNS as a build argument (ELBDNS).
Local Test Run	docker run -d -p 80:80 storyizer/website	Run the container locally, mapping port 80 to test the configuration.
Stop Container	`CONTAINER_ID=$(docker ps	grep storyizer/website

```
sh-5.2$ export ALB_DNS_NAME=$(aws elbv2 describe-load-balancers --names StoryizerAELB | jq -r '.LoadBalancers[0].DNSName')
echo "Your ALB DNS name is $ALB_DNS_NAME"
Your ALB DNS name is StoryizerAELB-1527170160.us-west-2.elb.amazonaws.com
sh-5.2$ docker build -t storyizer/website --build-arg ELBDNS=$ALB_DNS_NAME .
[+] Building 82.1s (9/9) FINISHED                                                                                    docker:default
 => [internal] load build definition from Dockerfile                                                                           0.0s
 => => transferring dockerfile: 575B                                                                                           0.0s
 => [internal] load metadata for docker.io/rockylinux/rockylinux:latest                                                        1.0s
 => [internal] load .dockerignore                                                                                              0.0s
 => => transferring context: 2B                                                                                                0.0s
 => [1/4] FROM docker.io/rockylinux/rockylinux:latest@sha256:fc370d748f4cd1e6ac3d1b6460fb82201897fa15a16f43e947940df5aca1a56e   5.4s
 => => resolve docker.io/rockylinux/rockylinux:latest@sha256:fc370d748f4cd1e6ac3d1b6460fb82201897fa15a16f43e947940df5aca1a56e  0.0s
 => => sha256:fc370d748f4cd1e6ac3d1b6460fb82201897fa15a16f43e947940df5aca1a56e 437B / 437B                                     0.0s
 => => sha256:2f0bf3347b762fb21264670b046758782673694883cdf031af3aba982f656830 518B / 518B                                     0.0s
 => => sha256:523ffac7fb2e245e5e7c407b9f7377be9c6c3bf03d380981168311f49030da17 627B / 627B                                     0.0s
 => => sha256:71cc2ddb2ecf0e2a974aec10b55487120f03759e86e08b50a7f4c5d77638ab9b 75.70MB / 75.70MB                               0.8s
 => => extracting sha256:71cc2ddb2ecf0e2a974aec10b55487120f03759e86e08b50a7f4c5d77638ab9b                                      4.5s
 => [internal] load build context                                                                                              0.0s
 => => transferring context: 109.08kB                                                                                          0.0s
 => [2/4] RUN yum -y update &&     yum -y install httpd unzip &&     yum clean all                                            67.5s
 => [3/4] COPY ./code/ /var/www/html/                                                                                          0.1s
 => [4/4] RUN echo "ServerName storyizer.training " >> /etc/httpd/conf/httpd.conf   && sed -i -- "s|APIELB|StoryizerAELB-1527170160.us-west-2.elb.amazo  0.6s
 => exporting to image                                                                                                         7.3s
 => => exporting layers                                                                                                        7.3s
 => => writing image sha256:cb666b5055b46266cc1ccaff4d371e59ee0a3d9de59a8bcad2fd79aecb5f1506                                   0.0s
 => => naming to docker.io/storyizer/website                                                                                   0.0s
sh-5.2$ docker images
REPOSITORY          TAG       IMAGE ID       CREATED          SIZE
storyizer/website   latest    cb666b5055b4   15 seconds ago   471MB
sh-5.2$ ls
Dockerfile  code
sh-5.2$ docker run -d -p 80:80 storyizer/website
af9bb2b235307b1ea12ed3c137ac2a0c9d6bf272d39980f97aa154ae9cd9923a
```

2. API Service (storyizer/api)

The API service uses Node.js (version 6.10.3) and is exposed on port 81.

API Dockerfile (API/Dockerfile)

```
cat Dockerfile
FROM rockylinux/rockylinux

# Replace shell with bash so we can source files
RUN rm /bin/sh && ln -s /bin/bash /bin/sh

RUN yum update -y \
   && yum install -y wget unzip

ENV NVM_DIR=/usr/local/nvm NODE_VERSION=6.10.3

RUN curl https://raw.githubusercontent.com/creationix/nvm/v0.33.2/install.sh | bash \
    && source $NVM_DIR/nvm.sh \
    && nvm install $NODE_VERSION \
    && nvm alias default $NODE_VERSION \
    && nvm use default

ENV NODE_PATH=$NVM_DIR/v$NODE_VERSION/lib/node_modules PATH=$NVM_DIR/versions/node/v$NODE_VERSION/bin/:$PATH

# Install app
COPY ./code/ /opt/
WORKDIR /opt/API

EXPOSE 81

CMD ["node", "/opt/API/app.js"]
sh-5.2$ docker build -t storyizer/api .
[+] Building 83.3s (11/11) FINISHED                                          docker:default
```

Commands Executed for API Build:

Step	Command Executed	Purpose
Navigate	cd ../API	Change to the API source directory.
Build Image	docker build -t storyizer/api .	Build the API image.

```
sh-5.2$ docker images
REPOSITORY          TAG       IMAGE ID       CREATED          SIZE
storyizer/api       latest    c48dbf02797f   18 seconds ago   625MB
storyizer/website   latest    cb666b5055b4   3 minutes ago    471MB
sh-5.2$ cd ../Save
sh-5.2$ docker build -t storyizer/save --build-arg AWSREGION=$AWS_REGION .
[+] Building 84.5s (12/12) FINISHED
```

3. Save Service (storyizer/save)

The Save service also uses Node.js and includes configuration to set the AWS region within the application's configuration file.

Commands Executed for Save Build:

Step	Command Executed	Purpose
Navigate	cd ../Save	Change to the Save source directory.
Build Image	docker build -t storyizer/save --build-arg AWSREGION=$AWS_REGION .	Build the Save image.

Phase 2: ECR Management and Image Push

After successfully building the three local images, I created dedicated ECR repositories for them and pushed the images.

Commands Executed for ECR Setup and Push:

```
sh-5.2$ docker ps
CONTAINER ID   IMAGE     COMMAND   CREATED   STATUS    PORTS     NAMES
sh-5.2$ export WEBSITE_URI=$( \
    aws ecr create-repository \
    --repository-name storyizer-website \
    --image-tag-mutability IMMUTABLE \
    --query 'repository.repositoryUri' \
    --output text
)
export SAVE_URI=$( \
    aws ecr create-repository \
    --repository-name storyizer-save \
    --image-tag-mutability IMMUTABLE \
    --query 'repository.repositoryUri' \
    --output text
)
export API_URI=$( \
    aws ecr create-repository \
    --repository-name storyizer-api \
    --image-tag-mutability IMMUTABLE \
    --query 'repository.repositoryUri' \
    --output text
)
```

Step	Command Executed	Purpose
ECR Login	`aws ecr get-login-password --region $AWS_REGION	docker login --username AWS --password-stdin $ACCOUNT_ID.dkr.ecr.$AWS_REGION.amazonaws.com`	
Tag Images	docker tag storyizer/website:latest $WEBSITE_URI:latest docker tag storyizer/save:latest $SAVE_URI:latest docker tag storyizer/api:latest $API_URI:latest	Tag local images to map them to the ECR repository URIs.
Push Images	docker push $WEBSITE_URI:latest docker push $SAVE_URI:latest docker push $API_URI:latest	Push all three images to their respective ECR repositories.

Phase 3: ECS Task Definition and Service Creation

This phase involved registering the ECS Task Definitions and creating the final ECS Services.

1. Task Definition Preparation

I used envsubst to dynamically replace environment variables (like $WEBSITE_URI and $ALB_DNS_NAME) within the JSON template files before registering the Task Definitions.

Commands Executed for Task Definition Registration:

```
for json_file in ~/scripts/*.json; do
    tempvalues=$(mktemp)
    envsubst < "$json_file" > "$tempvalues"
    mv "$tempvalues" "$json_file"
done
```

```
sh-5.2$ SITE_TASK_DEF=$(aws ecs register-task-definition --family Storyizer-Site --cpu 512 --memory 300 --requires-compatibilities EC2 --network-mode bridge -
-execution-role-arn arn:aws:iam::$ACCOUNT_ID:role/ecsTaskExecutionRole --cli-input-json file://~/scripts/Site.json --query 'taskDefinition.taskDefinitionArn'
--output text)

API_TASK_DEF=$(aws ecs register-task-definition --family Storyizer-API --cpu 512 --memory 300 --requires-compatibilities EC2 --network-mode bridge --execution
-role-arn arn:aws:iam::$ACCOUNT_ID:role/ecsTaskExecutionRole --cli-input-json file://~/scripts/API.json --query 'taskDefinition.taskDefinitionArn' --output te
xt)

SAVE_TASK_DEF=$(aws ecs register-task-definition --family Storyizer-Save --cpu 512 --memory 300 --requires-compatibilities EC2 --network-mode bridge --task-ro
le-arn arn:aws:iam::$ACCOUNT_ID:role/ecsTaskExecutionRole --cli-input-json file://~/scripts/Save.json --query 'taskDefinition.taskDefinitionArn' --output text
)

echo "The Storyizer-Site task definition is $SITE_TASK_DEF" && echo "The Storyizer-API task definition is $API_TASK_DEF" && echo "The Storyizer-Save task defi
nition is $SAVE_TASK_DEF"
The Storyizer-Site task definition is arn:aws:ecs:us-west-2:914483362358:task-definition/Storyizer-Site:1
The Storyizer-API task definition is arn:aws:ecs:us-west-2:914483362358:task-definition/Storyizer-API:1
The Storyizer-Save task definition is arn:aws:ecs:us-west-2:914483362358:task-definition/Storyizer-Save:1
```

2. Target Group Retrieval and Service Creation

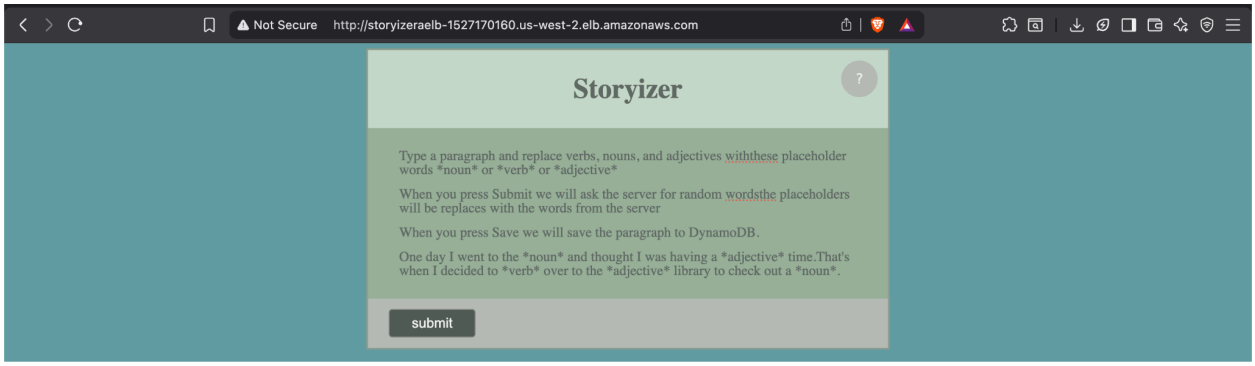
I retrieved the ARNs of the existing Load Balancer Target Groups and used them to create the ECS Services, mapping the containers to the respective Load Balancer Listener ports.

Commands Executed for Target Group Retrieval:

```
sh-5.2$ SITE_TARGET_GROUP_ARN=$(aws elbv2 describe-target-groups --names WebSiteTG80 --query 'TargetGroups[0].TargetGroupArn' --output text)

API_TARGET_GROUP_ARN=$(aws elbv2 describe-target-groups --names ApiTG81 --query 'TargetGroups[0].TargetGroupArn' --output text)

SAVE_TARGET_GROUP_ARN=$(aws elbv2 describe-target-groups --names SaveTG82 --query 'TargetGroups[0].TargetGroupArn' --output text)

echo "The WebSiteTG80 target group is $SITE_TARGET_GROUP_ARN" && echo "The ApiTG81 target group is $API_TARGET_GROUP_ARN" && echo "The SaveTG82 target group i
s $SAVE_TARGET_GROUP_ARN"
The WebSiteTG80 target group is arn:aws:elasticloadbalancing:us-west-2:914483362358:targetgroup/WebSiteTG80/43d707e68312c369
The ApiTG81 target group is arn:aws:elasticloadbalancing:us-west-2:914483362358:targetgroup/ApiTG81/9760b247c4c8d13f
The SaveTG82 target group is arn:aws:elasticloadbalancing:us-west-2:914483362358:targetgroup/SaveTG82/70830bf2a788da48
```

Commands Executed for Service Creation:

```
sh-5.2$ aws ecs create-service --service-name WebSiteService --cluster arn:aws:ecs:$AWS_REGION:$ACCOUNT_ID:cluster/Storyizer-Cluster --desired-count 2 --load-
balancers targetGroupArn=$SITE_TARGET_GROUP_ARN,containerName=Storyizer-Site,containerPort=80 --role arn:aws:iam::$ACCOUNT_ID:role/ECSServiceRole --task-defin
ition "$SITE_TASK_DEF" --launch-type EC2 --query 'service.serviceArn' --output text

aws ecs create-service --service-name ApiService --cluster arn:aws:ecs:$AWS_REGION:$ACCOUNT_ID:cluster/Storyizer-Cluster --desired-count 2 --load-balancers ta
rgetGroupArn=$API_TARGET_GROUP_ARN,containerName=Storyizer-API,containerPort=81 --role arn:aws:iam::$ACCOUNT_ID:role/ECSServiceRole --task-definition "$API_TA
SK_DEF" --launch-type EC2 --query 'service.serviceArn' --output text

aws ecs create-service --service-name SaveService --cluster arn:aws:ecs:$AWS_REGION:$ACCOUNT_ID:cluster/Storyizer-Cluster --desired-count 1 --load-balancers t
argetGroupArn=$SAVE_TARGET_GROUP_ARN,containerName=Storyizer-Save,containerPort=82 --role arn:aws:iam::$ACCOUNT_ID:role/ECSServiceRole --task-definition "$SAV
E_TASK_DEF" --launch-type EC2 --query 'service.serviceArn' --output text
arn:aws:ecs:us-west-2:914483362358:service/Storyizer-Cluster/WebSiteService
arn:aws:ecs:us-west-2:914483362358:service/Storyizer-Cluster/ApiService
arn:aws:ecs:us-west-2:914483362358:service/Storyizer-Cluster/SaveService
```



This project successfully demonstrated the end-to-end process of multi-container deployment on AWS, from packaging the application with Docker to managing redundant services with ECS, all running on the EC2 launch type.