Spark Session: ft_server

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Project description:

> Discover Docker and set up your first web server.

Topics

1. Virtual Machines
2. Containers
3. Docker Tutorial

Virtual Machines

1. Traditionally, organizations would run applications on physical servers. This was both expensive to maintain and did not scale well.
 Virtualization was a solution to this. What is virtualization and what issues does it solve? (15 mins)
   > Virtualization is technology that allows you to divide a system's resources more
   > efficiently by running multiple Virtual Machines (VMs) on a single physical server's CPU.
   >
   > Advantages: security (isolation between VMs); flexibility (applications aren't limited by
   > host hardware); cost and time efficiency (instantly create VMs, less machines needed);
   > more portable (self-contained machines, so can be moved across different servers as needed
   > without concern for hardware)
   >
   > What is virtualization
2. What is a virtual machine (VM)? What is a hypervisor? (5 mins)
   > VMs run applications inside a guest Operating System, which runs on virtual hardware
   > powered by the server’s host OS.
   >
   > Hypervisor is software that takes the host computer's physical resources - such as memory
   > and processing - and divides them up to support multiple guest VMs

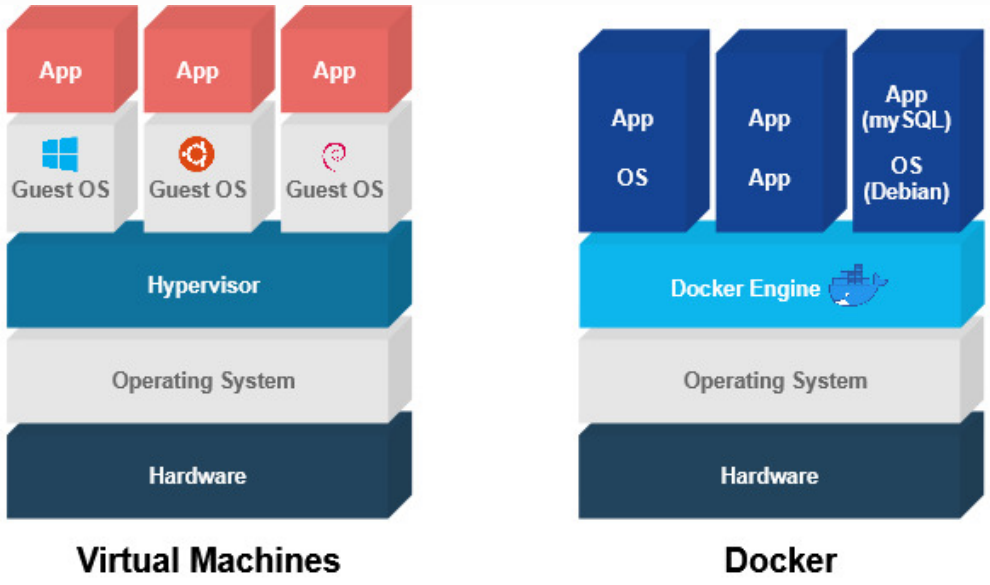
Containers

1. VMs are, however, still resource-heavy as each VM is its own full machine with its own resource needs.
   Containerization provides a more lightweight alternative to that. What are containers? How are they similar yet different from VMs? (20 mins)
   > A container packages up the code and all its dependencies so that it can be deployed

> quickly and reliably.
> Any changes/processes in these containers are isolated from other containers and the host
> machine.
>
> Similarity: flexibility - VMs allow multiple operating systems regardless of hardware ,containers allow applications regardless of OS.
>
> Difference: containers are more lightweight because they use only what they need of the host
 > system's resources, unlike VMs that reserve resources; containers are less isolated
>
> Traditional vs VMs vs Container deployment
>
> What is a container and comparison with VMs

2. Where does Docker fit into this picture? Why would you use container technology like Docker? (10 mins)

    > Docker is one implementation of container-technology out of many
    >
    > Why: standardization (bundling applications with all their dependencies makes it extremely
    > portable), security (isolated), low overhead (fast and lightweight)



Break (5 mins)

Docker Tutorial

Set Up

For this session, we'll be using **Play with Docker** to follow Docker's own tutorial! Here's how to set it up: (10 mins)

1. If you don't have it already, register for a Docker ID: https://docs.docker.com/docker-id/

2. Go to https://labs.play-with-docker.com/ and log in.
3. Type the following command in the black PWD terminal:
 `docker run -dp 80:80 docker/getting-started:pwd` *(Copy-paste hint: Shift+Insert)*
4. Wait for it to start the container and click the **port 80** badge above the terminal.

Introduction to Docker

Tutorial page: Getting Started

1. Let's break down that `docker run -d -p 80:80 docker/getting-started:pwd` command you just executed. What does each part mean? (10 mins)
2. Why port 80? What is HTTP? (15 mins)
   > Port 80 is the port number assigned to HTTP, an internet communication protocol.
   > It is the port used by a Web/HTTP client (e.g. a Web browser) to send and receive requested > Web pages from a server.
   >
   > Simple explanation
   >
   > Hypertext Transfer Protocol is the format that is used to structure requests and responses for effective communication between a client and a server over the internet. The message
   > that is sent by a client to a server is what is known as an HTTP request.
   >
   > Explanation with fun analogy
3. We've talked about what containers are. But what is a container image? (10 mins)
   > An image is a lightweight, standalone, executable package of software that includes everything needed to run an application: code, runtime, system tools, system libraries and settings.

Break (5 mins)

Building an Image and Running a Container

Tutorial page: Our Application

Let's start learning how to use Docker by getting a little to-do list page up and running! (20 mins)

1. Follow the instructions under **"Getting our App into PWD"** to get the application source code into your Play with Docker environment.
   - When you're done, do you see the files in `app/` as shown in the tutorial?
2. Now create a Dockerfile in the PWD environment with the code from the tutorial (you can use vim)
   - What is a Dockerfile?
3. Build the container image using `docker build -t docker-101 .`
   - What happened when you ran that command?
4. Start up the container using `docker run -dp 3000:3000 docker-101`
   - Recall what we discussed earlier. What does each component of this command mean?
5. Click on the port **3000** badge at the top of your PWD interface. Do you see your lovely empty to-do list? Try adding an item or two!

Stopping and Removing Containers

Tutorial page: Updating our App

Let's see how we can implement a change in our image. (15 mins)

1. Change the code on line **56** in `app.js` as specified in the tutorial.
2. Let's try building this newest version of the image with
 `docker build -t docker-101 .`
3. What happens if you execute `docker run -dp 3000:3000 docker-101` like last time?
   > Will error because only one process can listen to a specific port at a time and the old container is still running
4. So we first need to stop our old container that still has the outdated code.
   - How can we see the currently running containers?
   - How can we stop a specific container?
 (Hint: do you have to type the entire container ID?)
5. Now that we've stopped the old container, we have to remove it. Execute the `docker rm` command shown in the tutorial.
   - There's also a way to stop and remove a container using a single command. What is it?
6. Try running your updated application again. Do you see your updated text?
   - But notice that all of the items you added to your previous list are gone! Let's address that next.

Persisting the Data

Tutorial page: Persisting our DB

Now let's learn about why our application data is wiped each time we launch it and how to prevent that. (30 mins)

1. Each container has its own filesystem and gets their own space to create and manipulate these files.\ Follow the instructions on the tutorial page to see how a file created in one container isn't available in another.
   - Look at the first `docker run` command. What does each part do? Run it to start the ubuntu container and create the `data.txt` file.
   - Run the `docker exec` command shown, using the container ID *(hint: `docker ps`)*. Do you see a random number?
   - **Extra step:** now try running `docker exec <container-id> ls`. Do you see the data.txt file?
   - Let's run a second container using the same image. Execute the `docker run` command shown. Notice that there's no `data.txt` file here.
   - You can remove the first container now using `docker rm -f <container-id>`.
2. What are container volumes?
3. Let's try creating and using a **named volume**. Do you know what that is? Run the `docker volume create` command shown.
4. Start your `docker-101` container again, but this time specifying a volume mount with the `-v` flag.
   - What does the `docker run` command shown do exactly?
5. Once your to-do list is up, try adding a few items to the list.

6. Now remove the container using `docker rm -f` .
7. Start a new container using the same `docker run` command you ran in step 4.
 If you open the app again, do you see the list items you added earlier?
8. Now let's see where Docker stores that data when you use a named volume.\ Run the `docker volume inspect` command shown in the tutorial.
    - What is a mountpoint?

Congratulations, now you know how to use volumes in Docker to preserve your application data!
Named volumes are one of the main types of volumes in Docker, **bind mounts** being the other.\
Feel free to try out the tutorial section on bind mounts on your own to see how you can rapidly implement changes in your source code by specifying the mountpoint.

Docker Environment Variables

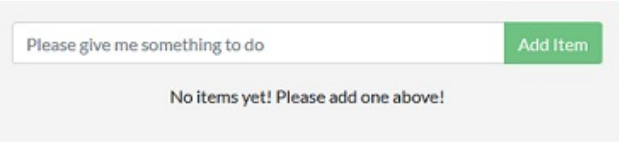
Docker's `ENV` instruction lets you use **environment variables** to set and modify configuration information to running containers. This way, you don't have to manually edit your configuration files!

1. First off, how would you declare an environment variable in your Dockerfile? (5 mins)
   > `ENV variable_name=variable_value`

2. Now let's try to change the "New Item" placeholder text in your to-do list! Using environment variables, we can dynamically change what text is displayed. (15 mins)
 Go into your Dockerfile and add the following things:

    - declare an environment variable called `NEW` and give it a default value ("What would you like to do today?", for example)
    - replace the last `CMD` instruction with this: *(make sure the instruction is on one line)*
      `CMD sed -i "99 s/New Item/${NEW}/g" /app/src/static/js/app.js && node /app/src/index.js`

3. Build your image with `docker build -t docker-101 .` and run it with
 `docker run -dp 3000:3000 docker-101` . Is the New Item text now replaced with the default value you gave `$NEW` ? (5 mins)

4. Now stop the container. Say we want to change the empty message to something else, "Please give me something to do" for example. How can we do that through `docker run` , **without changing the Dockerfile or rebuilding**? (15 mins)
 Did you manage to change your placeholder text?
   

   > `docker run -e NEW="Please give me something to do" -dp 3000:3000 docker-101`

5. Let's go back to that `CMD sed` instruction I helpfully provided earlier. (15 mins)

    - What does each part of the `sed` command mean?

      > sed {don't print to stdout} "{line no.} s/{change this}/{to this}/g"

    - Why did I use `CMD` and not `RUN` ?

> RUN is executed at build-time, whereas CMD is at run-time. Using `RUN sed` would mean
> `$NEW` always equates to the default value.

- Can you have multiple `CMD` instructions in a single Dockerfile?

> There can only be one CMD command in the Dockerfile. So either commands need to be
> chained with `&&` or executed through a bash script.

Now you know how to use environment variables to allow for more dynamic environment configuration. This will come in handy for certain parts of the project that require toggling settings or passing credentials.

```
#example Dockerfile
FROM node:10-alpine
ENV NEW="What would you like to do today?"
WORKDIR /app
COPY . .
RUN yarn install --production
CMD sed -i "99 s/New Item/${NEW}/g" /app/src/static/js/app.js && node /app/src/index.js
```