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**Presidential Initiative for Artificial Intelligence and Computing (PIAIC)**

https://www.piaic.org

**Artificial Intelligence of Things (AIoT) Specialist Program**

Course Syllabus

**Quarter III: IoT-301 Cloud Native and Edge Computing for IoT**

Version 1.0.0 - 2020 (12 Weeks)

**Teaching Team: Imran Ali, Dr. Gufran Khan, Muhammad Inzamam Malik, Faheem Uz Zaman, Shahrukh Haider, Anas Baig, Zain Ul Abdin, Zobia Kanwal, Ukasha Sohail, Sheikh Hassaan Bin Nadeem, Muhammad Naufil, Muhammad Hammad, Ali Raza Qureshi, Muhammad Rajab Raza, Mohd Jamshaid Tahiri, Muhammad Talha Desai, Muhammad Areeb Siddiqui, Muhammad Ovais, Saif Ali, Kashif Haider Ali, Amir Nakhwa, Mirza Hassan, Muhammad Owais, Muhammad Jawwad, Abdul Rehman Siddiqui, Muhammad Umer, Muhammad Danial Siddiqui, Hanzala Ejaz, Arsalan Nawaz Khan, Syed Hasan Ali, Muhammad Anas, and Gulfam Asif**

**Class Duration: 4 hours**

**Course Description:** In this course we will learn how to develop cloud-based microservies using Docker, Kubernetes, Async Rust, Hyper and Diesel. We will also cover Edge Computing using KubeEdge.

**Please bring a Laptop, STM32F3, and Raspberry Pi 4 with you for the Classes (Required, but not mandatory)**

**Textbooks and Reading Material:**

1. [Linux: Easy Linux for Beginners by Felix Alvaro](https://www.amazon.com/LINUX-Beginners-Step-Step-Operating-ebook/dp/B01CF1FORK)
2. [Docker Deep Dive by Nigel Poulton](https://www.amazon.com/Docker-Deep-Dive-Nigel-Poulton-ebook/dp/B01LXWQUFF/ref=sr_1_1)
3. [Kubernetes in Action by Marko Lukša](https://www.manning.com/books/kubernetes-in-action)

**Reference books:**

1. Hands-On Industrial Internet of Things: Create a powerful Industrial IoT infrastructure using Industry 4.0

by Giacomo Veneri, Antonio Capasso

<https://www.amazon.com/dp/1789537223/ref=cm_sw_em_r_mt_dp_U_zybCCbZVJ11SP>

<http://jugsi.blogspot.com/2019/03/is-kube-edge-right-industrial-iot-edge.html>

1. Hands-On Microservices with Rust

<https://www.oreilly.com/library/view/hands-on-microservices-with/9781789342758/>

**PIAIC Announcements Facebook Group:** <https://www.facebook.com/groups/piaic/>

**Course Facebook Group:** <https://www.facebook.com/groups/aiot.edu/>

**Portal for online and onsite students:**

<https://portal.piaic.org/>

**Ask Questions:**

<https://ask.piaic.org/>

**Chat on Telegram:**

Channel Name: PIAIC-IoT

<https://t.me/piaic_iot>

**Grading:**

Students will be graded based on Percentile

<https://en.wikipedia.org/wiki/Percentile>

<https://en.wikipedia.org/wiki/Percentile_rank>

A-Grade: 78- 99 Percentile

B-Grade: 41- 77 Percentile

C-Grade: 23- 40 Percentile

D-Grade: 1 - 22 Percentile

F-Grade: Anyone who doesn’t appear in two or more exams

Note: Anyone who receives a F-Grade will be removed from the program. Students who receive a D-Grade will be put on probation, and be required to earn a grade of C or above in the next quarter, to remain in the program. Anyone absent from an exam will be deemed to have received a score of zero.

**Important Note:**

If a PIAIC candidate doesn’t appear in a Quiz at the scheduled time announced by management 10% score will be deducted from the test score for every week of delay.

**Course Outline:**

1. **Linux for Beginners**

(**Videos and reading material available on Student Portal to prepare for Linux Quiz, Linux will not be covered in class to save class time)**

Chapters 1, 2, 4, 5, 7, 8, and 9 from Linux: Easy Linux for Beginners by Felix Alvaro

We will use Ubuntu:

<https://tutorials.ubuntu.com/tutorial/tutorial-ubuntu-on-windows#0>

or

<https://www.lifewire.com/run-ubuntu-within-windows-virtualbox-2202098>

**Linux for Beginners Quiz in Week 2**

Total Questions: 32, Total Time: 40 minutes

1. **Docker Deep Dive**

(**Videos and reading material available on Student Portal to prepare for Docker Quiz, Docker will not be covered in class to save class time)**

Chapters 1 to 8 of Docker Deep Dive book by Nigel Poulton

You will also need to learn the mounting of host directories in the containers. To learn how to mount local directory with -v flag read from here:

<https://docs.docker.com/engine/admin/volumes/bind-mounts/#choosing-the--v-or-mount-flag>

Homework Videos:

<https://www.youtube.com/watch?v=EnJ7qX9fkcU>

<https://www.youtube.com/watch?v=cCTLjAdIQho>

<https://www.youtube.com/watch?v=76rX4s73MrM>

**Docker Quiz in Week 4**

Total Questions: 25, Total Time: 40 min

1. **Asynchronous Programming** (Week 1 to 2)

Sections 1.1, and 1.3 from:

<https://rust-lang.github.io/async-book/>

<https://thomashartmann.dev/blog/async-rust/>

<https://tokio.rs/docs/getting-started/hello-world/>

<https://tokio.rs/docs/getting-started/futures/>

<https://tokio.rs/docs/getting-started/runtime/>

**Asynchronous Programming Quiz in Week 6**

Total Questions 50, Total Time: 75 mins

1. **Asynchronous Microservices** (Week 3 to 5)

<https://towardsdatascience.com/microservice-architecture-a-brief-overview-and-why-you-should-use-it-in-your-next-project-a17b6e19adfd>

Sections 1.1, and 1.3 from:

<https://rust-lang.github.io/async-book/>

<https://thomashartmann.dev/blog/async-rust/>

<https://tokio.rs/docs/getting-started/hello-world/>

<https://tokio.rs/docs/getting-started/futures/>

<https://tokio.rs/docs/getting-started/runtime/>

<https://hyper.rs/guides/server/hello-world/>

<https://hyper.rs/guides/server/echo/>

<https://github.com/seanmonstar/reqwest>

<https://hyper.rs/guides/server/graceful-shutdown/>

<https://docs.mongodb.com/manual/introduction/>

<https://docs.mongodb.com/manual/tutorial/getting-started/>

<https://docs.mongodb.com/manual/tutorial/update-documents/>

<https://docs.mongodb.com/manual/tutorial/query-documents/>

<https://github.com/mongodb/mongo-rust-driver>

<https://towardsdatascience.com/effective-microservices-10-best-practices-c6e4ba0c6ee2>

**Asynchronous Microservices Quiz in Week 6**

Total Questions 50, Total Time: 75 mins

1. **Kubernetes in Practice Introduction** (Week 6 and 7)

Chapter 2 and 3 of Kubernetes in Action

Appendix A: Using kubectl with multiple clusters from Kubernetes in Action

**Kubernetes in Practice Quiz 1 in Week 8**

Total Questions: 40, Total Time: 60 minutes

1. **Programming the Edge using Raspberry Pi 4 Model B** (Week 8 to 9)

<https://projects.raspberrypi.org/en/projects/raspberry-pi-setting-up/>

<https://www.youtube.com/watch?v=KJV9kL-xouc>

<https://opensource.com/article/19/3/physical-computing-rust-raspberry-pi>

<https://github.com/golemparts/rppal/>

Where to buy? (Optional)

<https://hobbytronics.pk/product/raspberry-pi-4/>

Note:

For those who cannot afford can use one of these:

<https://windowsreport.com/raspberry-pi-emulators/>

1. **Edge Computing with KubeEdge** (Week 10, 11, and 12)

<https://kubeedge.readthedocs.io/en/latest/>

<https://thenewstack.io/kubeedge-extends-the-power-of-kubernetes-to-the-edge/>

<https://kubeedge.readthedocs.io/en/latest/setup/installer_setup.html>

<https://kubeedge.readthedocs.io/en/latest/modules/kubeedge.html>

<https://kubeedge.readthedocs.io/en/latest/modules/edge/edged.html>

<https://kubeedge.readthedocs.io/en/latest/modules/beehive.html>

<https://github.com/kubeedge/examples>

**Edge Computing Quiz in Week 13**

**Programming Assignments will also be given.**

**The speed of the class will depend on how much students are able to absorb the material. If some material is left after the end of the third quarter it will be taught in the fourth quarter but the sequence will remain exactly as above.**