MAE 6291
Internet of Things for Engineers

Prof. Kartik Bulusu, MAE Dept.

| Week 13 [04/23/2025] | • Final presentations and demos
• Advanced topics
  • Full stack development in the IoT space
    • Docker
    • Kubernetes – k3S, microK8s
• Some light reading for the future
• Future directions | • Docker example |

git clone https://github.com/gwu-mae6291-iot/spring2025_codes.git

GW School of Engineering & Applied Science

THE GEORGE WASHINGTON UNIVERSITY

Spring 2025

Information for this slide deck is sourced from the following links:

https://www.einfochips.com/blog/full-stack-development-for-iot

fullstack by iconfield from https://thenounproject.com/browse/icons/term/fullstack/ (CC BY 3.0)

databse by White Snow from https://thenounproject.com/browse/icons/term/databse/ CC BY 3.0)

html by meilia miftah choirun niswah from https://thenounproject.com/browse/icons/term/html/ (CC BY 3.0)

CSS by meilia miftah choirun niswah from https://thenounproject.com/browse/icons/term/css/ (CC BY 3.0)

json by ME from https://thenounproject.com/browse/icons/term/json/ (CC BY 3.0)

javascript by I Putu Kharismayadi from https://thenounproject.com/browse/icons/term/javascript/ (CC BY 3.0)

Tux By Larry Ewing, Simon Budig, Garrett LeSage - https://isc.tamu.edu/~lewing/linux/ , http://www.home.unix-ag.org/simon/penguin/, garrett/Tux on GitHub, CC0, https://commons.wikimedia.org/w/index.php?curid=753970

PhP By Colin Viebrock - http://php.net/logos, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=9632398

Perl By https://seeklogo.com/vector-logo/107704/perl, Fair use, https://en.wikipedia.org/w/index.php?curid=69091026

Java By http://www.logoeps.com/java-eps-vector-logo/40925/, Fair use, https://en.wikipedia.org/w/index.php?curid=51298819

Programming paradigms https://en.wikipedia.org/wiki/Programming_paradigm

Python By www.python.org - www.python.org, GPL, https://commons.wikimedia.org/w/index.php?curid=34991651

Ruby By Yukihiro Matsumoto, Ruby Visual Identity Team - https://www.ruby-lang.org/en/about/logo/, CC BY-SA 2.5, https://commons.wikimedia.org/w/index.php?curid=3239992

AWS By Amazon.com Inc. - Amazon, Apache License 2.0, https://commons.wikimedia.org/w/index.php?curid=62382835

By Google - gstatic.com/devrel-devsite/prod/vbd0faab6c0701e17b2f66039dd03326fc0e1627ecbcddaec4cd383df8dda622c/cloud/images/cloud-logo.svg, Public Domain, https://commons.wikimedia.org/w/index.php?curid=116086256

IBM Cloud By ShinySummer - Own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=90179230

Orcale cloud By The logo may be obtained from Oracle Cloud., Fair use, https://en.wikipedia.org/w/index.php?curid=69897047

MySQL By Vectorised from https://labs.mysql.com/common/logos/mysql-logo.svg, Fair use, https://en.wikipedia.org/w/index.php?curid=67634535

Sqlite By Part of the SQLite documentation, which has been released by author D. Richard Hipp to the public domain. Public Domain, https://commons.wikimedia.org/w/index.php?curid=11675072
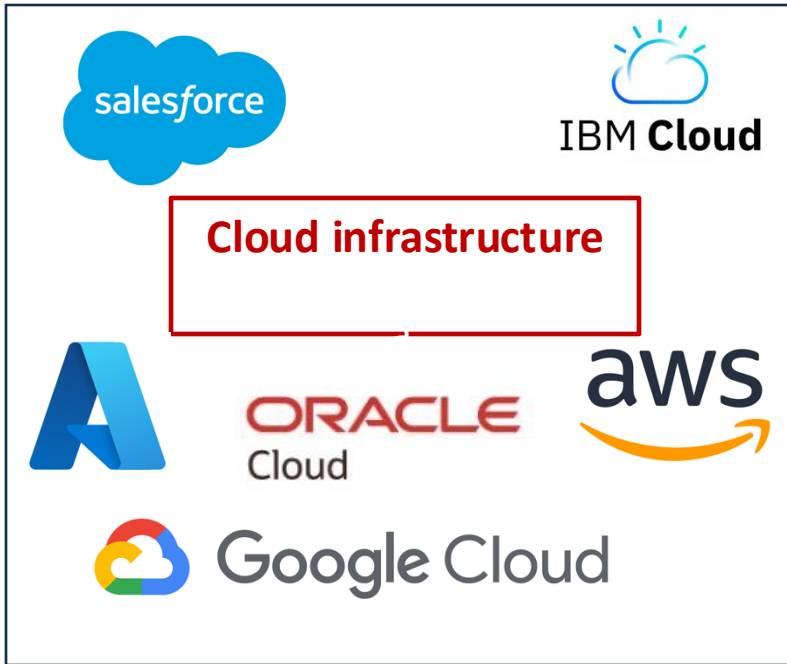
InfluxDB By InfluxData - https://influxdata.github.io/design.influxdata.com/branding-docs/img/influxdb/preview.svg, Public Domain, https://commons.wikimedia.org/w/index.php?curid=55056027

Dataset of legitimate IoT data https://www.data.gouv.fr/en/datasets/dataset-of-legitimate-iot-data/#/resources

Angular By Google Inc, CC BY 4.0, https://commons.wikimedia.org/w/index.php?curid=163088615

React JS by By Meta Platforms - https://svgmix.com/item/XJQENg/react, Public Domain, https://commons.wikimedia.org/w/index.php?curid=140630067

School of Engineering & Applied Science
THE GEORGE WASHINGTON UNIVERSITY

GW

Prof. Kartik Bulusu, MAE Dept.
MAE 6291

Spring 2025
Internet of Things for Engineers

Full Stack Development
for
IoT technologies

Cloud infrastructure

Front-end

Database

Back-end

- Embedded/firmware systems
- Communication technologies
- Networking protocol
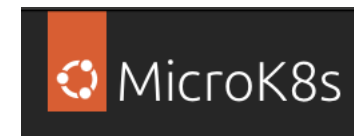- Sensor technology
- Custom-built hardware.

School of Engineering & Applied Science
THE GEORGE WASHINGTON UNIVERSITY

Prof. Kartik Bulusu, MAE Dept.
MAE 6291

Spring 2025
Internet of Things for Engineers

Advanced topics in IoT

K3S

The certified Kubernetes distribution built for IoT & Edge computing

MicroK8s
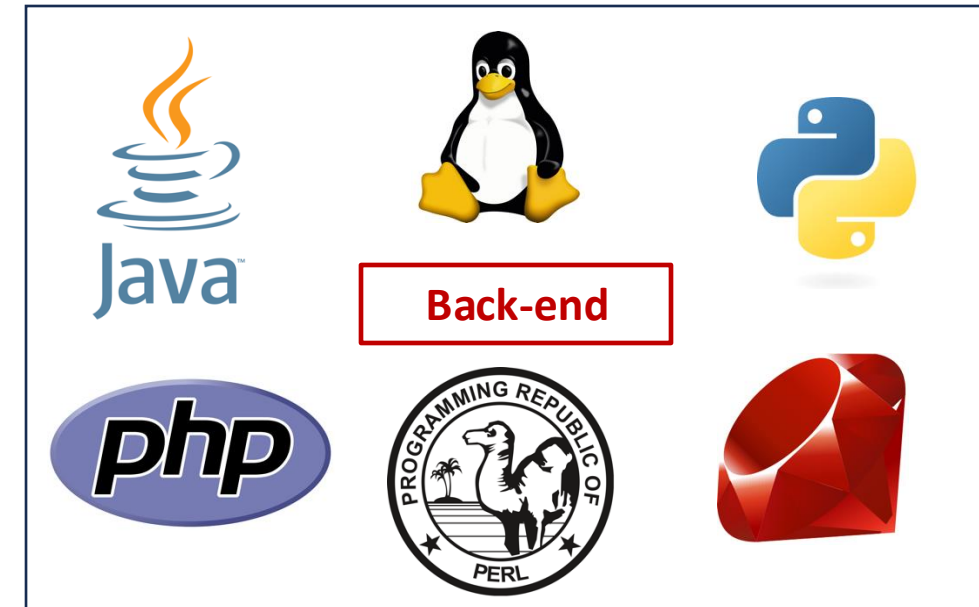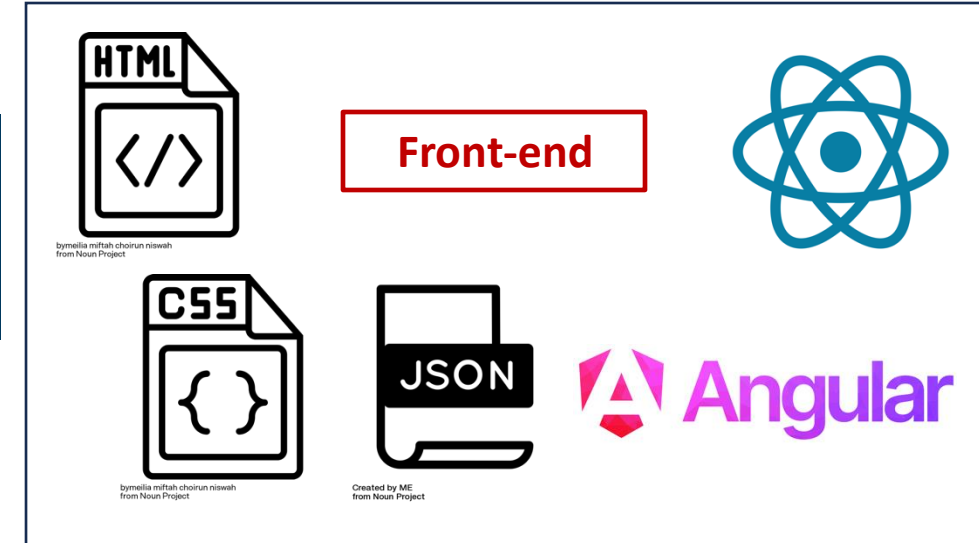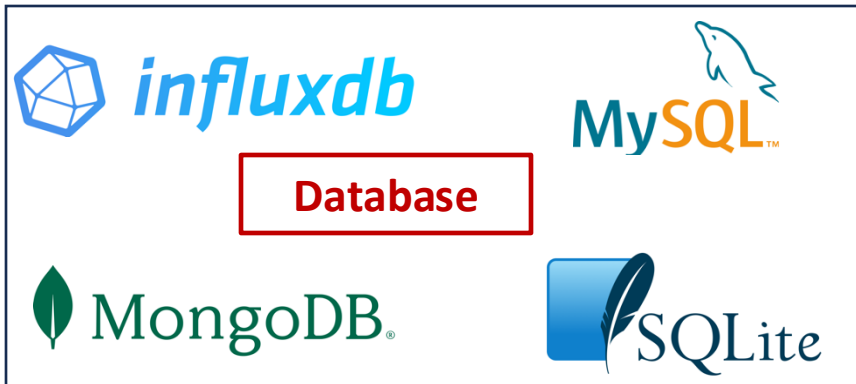
Docker is a set of platform as a service (PaaS) products that use OS-level virtualization to deliver software in packages called *containers*.

Kubernetes also known as **K8s** is an open-source container orchestration system for automating software deployment, scaling, and management

School of Engineering & Applied Science
THE GEORGE WASHINGTON UNIVERSITY

GW

Prof. Kartik Bulusu, MAE Dept.   Spring 2025

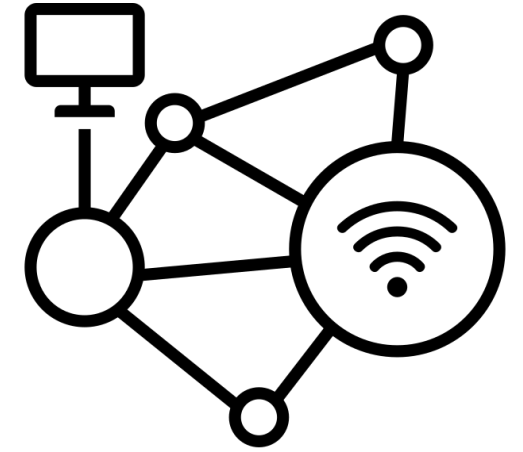MAE 6291   Internet of Things for Engineers

IoT devices are everywhere...

- **1st industrial revolution:** *1760 to 1840* -> Railroads

- **2nd industrial revolution:** *Late 19th centaury to 20th centaury* -> Mass production and electricity

- **3rd industrial revolution:** *1960s* -> Digital and revolution

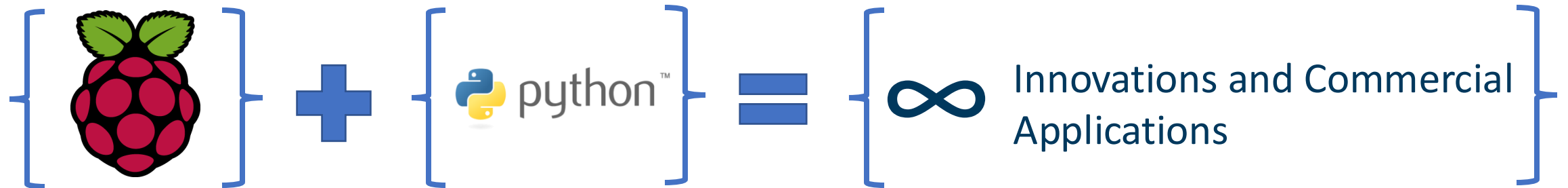- **4th industrial revolution:** *NOW* -> Ubiquitous and mobile communication

IoT with edge computing capability is going to be the backbone of the Industry 4.0.

- You **explored** the **IoT** framework
- **Expanded** it with **edge computing** ideology
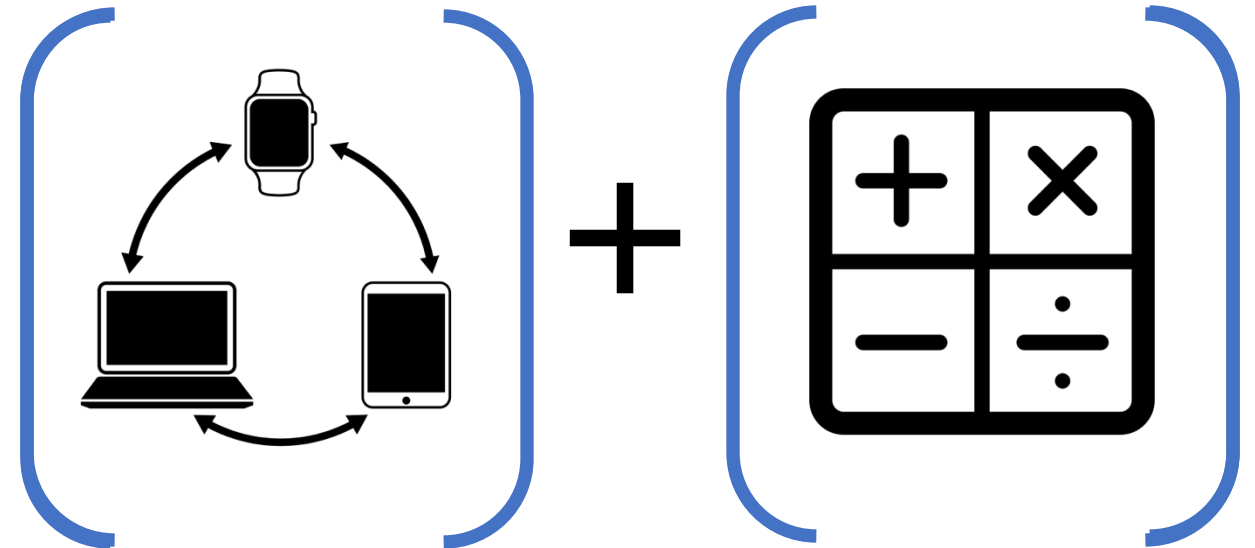- **Gained** practical and hands-on **exposure** in "**μ-Labs**"

{ 🍓 } + { 🐍 python™ } = { ∞ Innovations and Commercial Applications }

What's the "thing"?

Paradigm #1

- A **thing** is self-contained and only operates within the confines of its physical shell.
  - **Thing** carries out only those functions that its designer envisioned when it was fabricated.
- The **thing** contains a powerful computer inside but is completely hidden from the user.
- The **thing** has firmware (not called software).

Paradigm #2

+

Paradigm #3

School of Engineering & Applied Science
THE GEORGE WASHINGTON UNIVERSITY

GW

Prof. Kartik Bulusu, MAE Dept.   Spring 2025
MAE 6291   Internet of Things for Engineers

How can you put what you learn into practice

Practice, practice, practice!

School of Engineering & Applied Science
THE GEORGE WASHINGTON UNIVERSITY

GW

Prof. Kartik Bulusu, MAE Dept.
MAE 6291

Spring 2025
Internet of Things for Engineers