

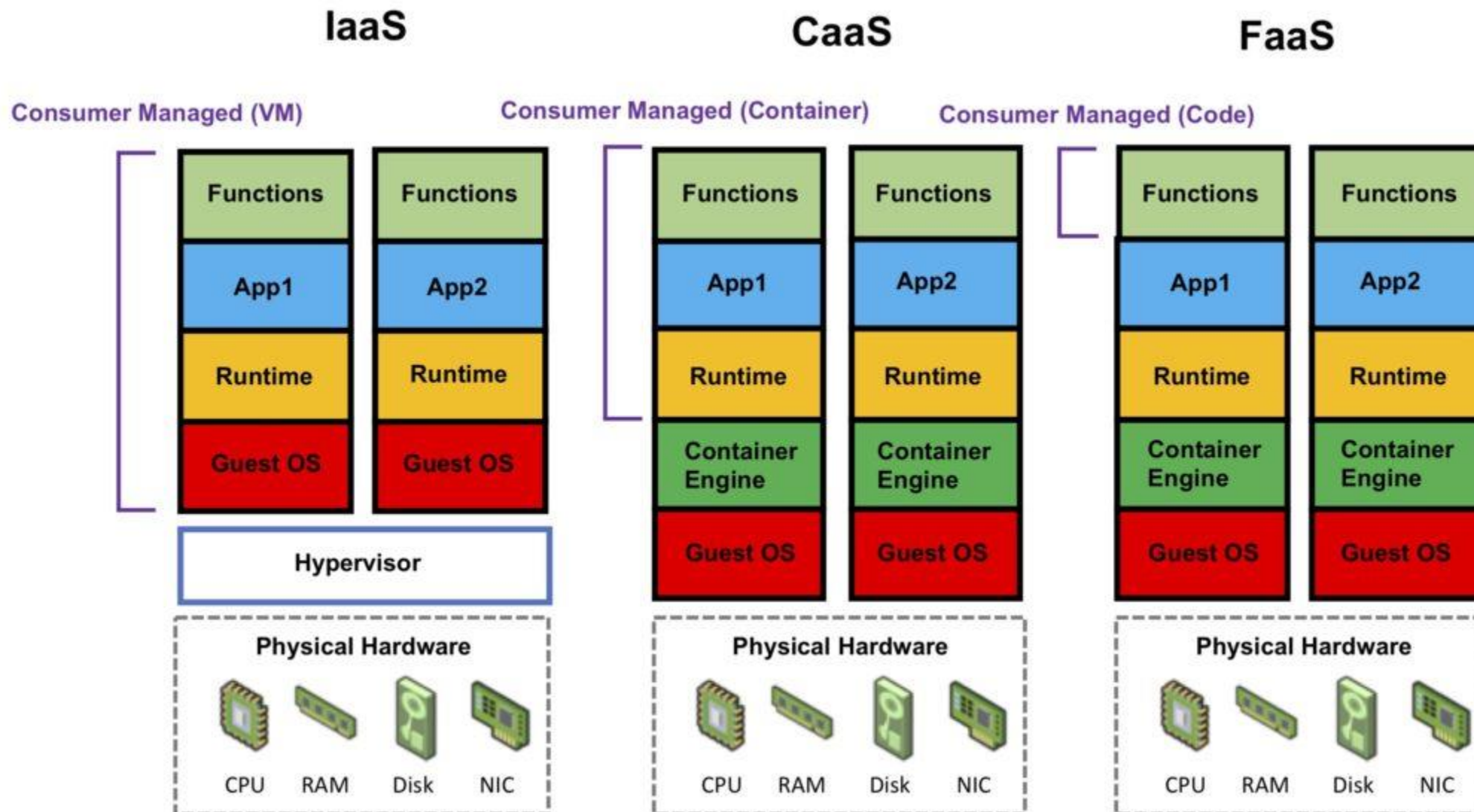
# Student projects

- Master/Bachelor Thesis, Semester project, Flexible collaboration
- Main research idea: serverless computing
  
- Projects are developed in a collaboration with other researchers from academia and industry.
- Our projects are research-based – goals and ideas change!
- Our work is always intended to be publishable.



**WE WANT YOU!**

# The Big Picture



# The Big Picture

|                         | AWS   | Azure                                       | Google  |
|-------------------------|---|---|---|
| <b>Memory (MB)</b>      | 64 * k<br>(k = 2, 3, ..., 24)                               | 1536  | 128 * k<br>(k = 1, 2, 4, 8, 16)                     |
| <b>CPU</b>              | Proportional to<br>Memory                                   | Unknown                                     | Proportional to<br>Memory                           |
| <b>Language</b>         | Python 2.7/3.6<br>Nodejs 4.3.2/6.10.3<br>Java 8, and others | Nodejs 6.11.5,<br>Python 2.7,<br>and others | Nodejs 6.5.0  |
| <b>Runtime OS</b>       | Amazon Linux  | Windows 10                                  | Debian 8*   |
| <b>Local disk (MB)</b>  | 512   | 500   | > 512   |
| <b>Run native code</b>  | Yes   | Yes   | Yes   |
| <b>Timeout (second)</b> | 300   | 600   | 540   |
| <b>Billing factor</b>   | Execution time<br>Allocated memory                          | Execution time<br>Consumed memory           | Execution time<br>Allocated memory<br>Allocated CPU |

# Why do we care?

- Quickly growing market
- High degree of parallelism
- Higher utilization of machines
- New, flexible way of running computations?

## The growing interest in serverless computing

Media mentions of "serverless" or "function-as-a-service," Q1 2013 – Q2 2018



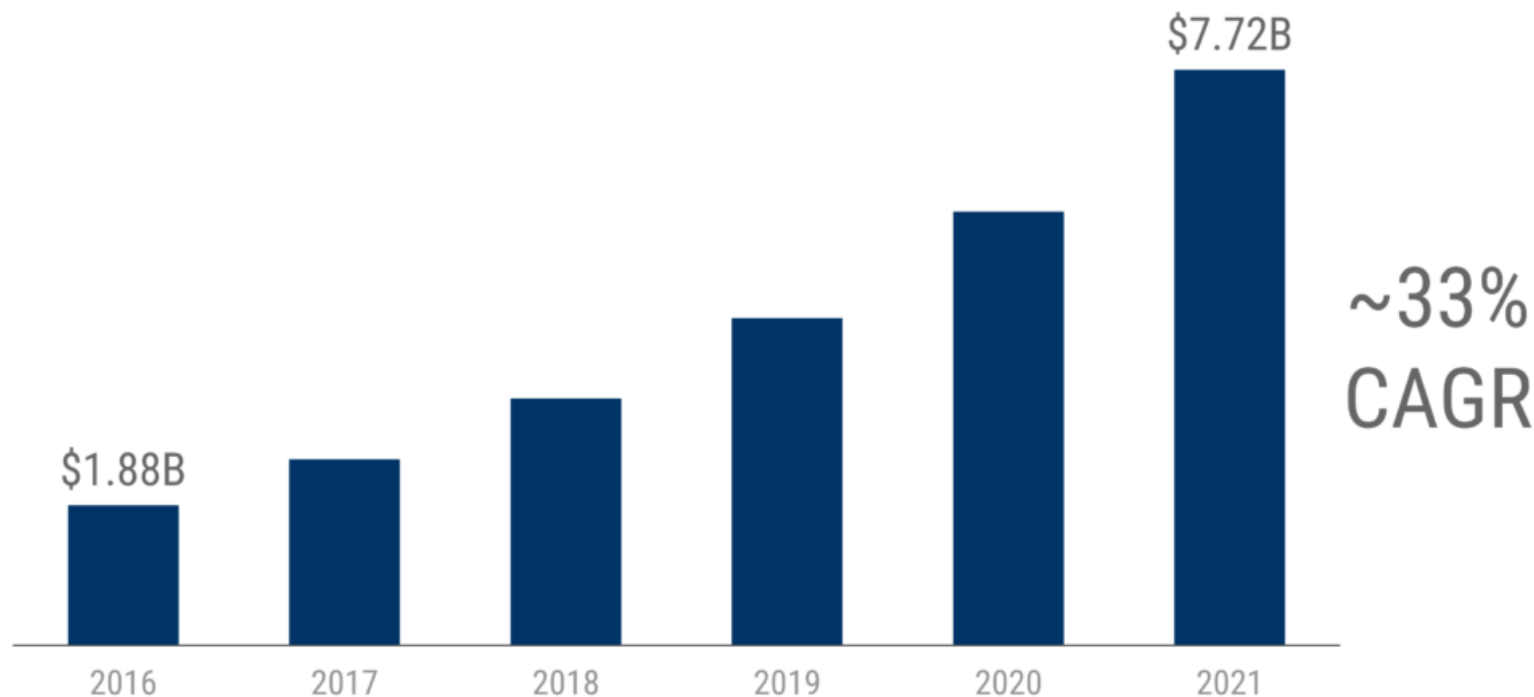
Source: CB Insights' Trends Tool

CBINSIGHTS

# Why do we care?

## The serverless market is expected to reach \$7.7B by 2021

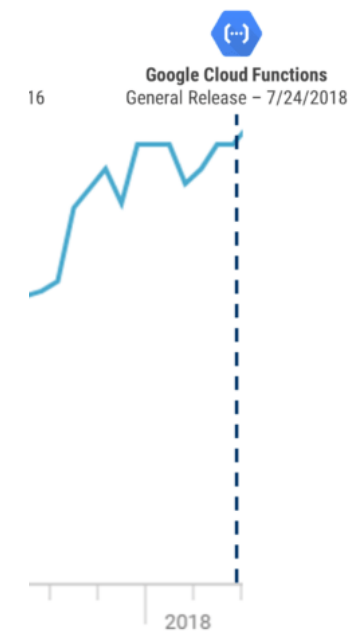
Estimated size of the serverless & function-as-a-service market annually, 2016 – 2021



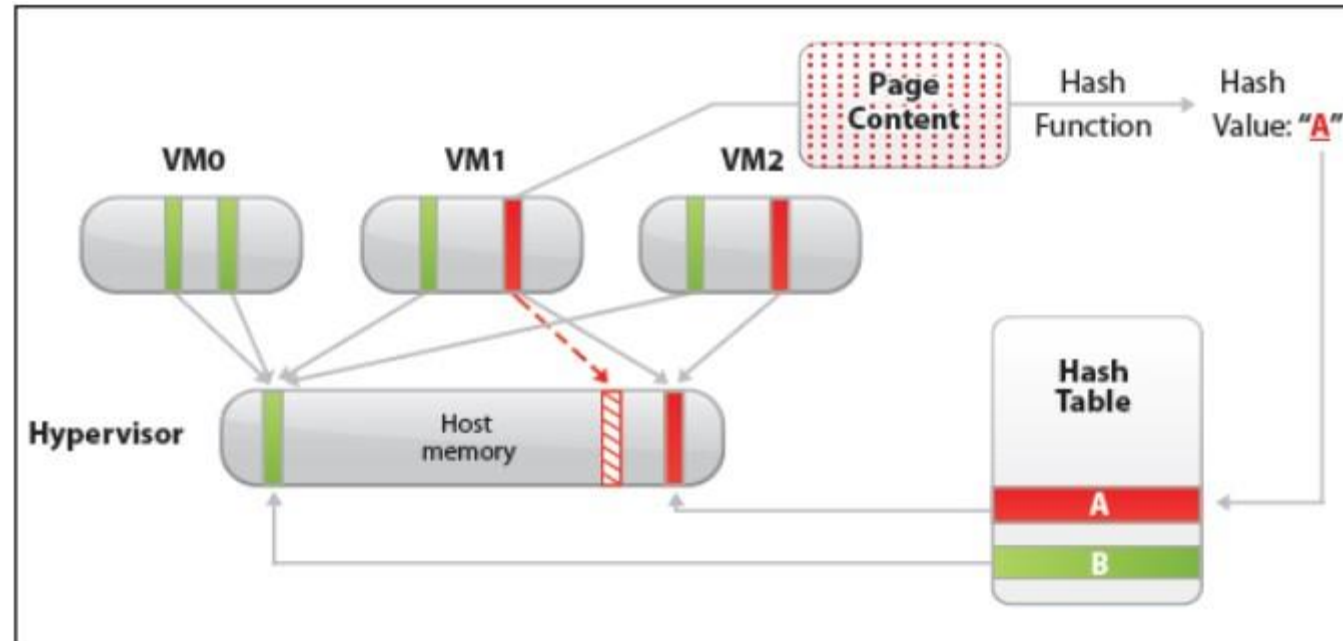
Source: CB Insights Market Sizing Tool; Research and Markets

## Computing

2013 – Q2 2018



# Memory in serverless computing

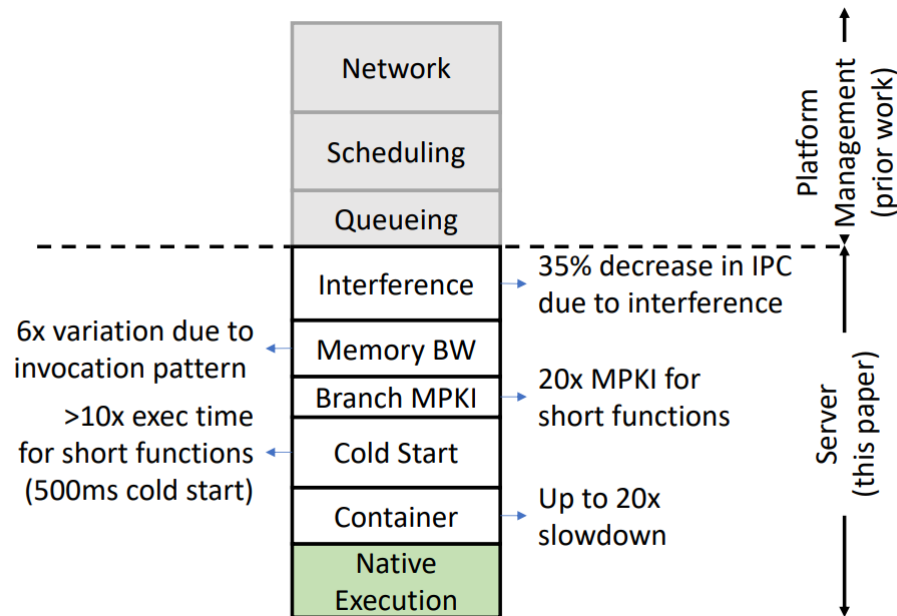


**Memory deduplication across virtual machines.  
Efficient but slow! It takes minutes to discover same pages.**

# Memory in serverless computing

- How much memory functions could share?
  - How 'different' are different pages?
  - How can we share memory faster?
  - Can we do deduplication on sub-page granularity?
  - Can we change the environment?
  - Can we help compilers to increase density of memory?
- 
- Interesting study of applications on new platform.
  - Goal: enable massive functions parallelism on a single machine.
  - Requirements: only basic knowledge on OS and willingness to learn 😊

# Microarchitectural implications



- Can we train branch predictor faster?
- Can we optimize cache hierarchy?
- Can we optimize TLBs?
- Ongoing project in collaboration.
- Goal: not only study differences but suggest solutions
- Requirements: interest in processor microarchitecture 😊



# Benchmarks

- **There's no good benchmarking suite for serverless!**
- **We're gathering multiple applications.**
- **Benchmark synthesis vs subsetting**
  
- **Ongoing project that's moving fast, looking for contributors!**
- **Requirements: interest in new platforms and building things!**

# HPC Functions

- **How we can efficiently synchronize and communicate?**
  - **How we can spawn functions very fast?**
  - **How we develop a programming model?**
  - **How we guarantee fault tolerance?**
- 
- **Large project with long-reaching goals.**
  - **Requirements: interest in breaking and optimizing frameworks and platforms.**

# Interested?

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