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.
The Big Picture

IaaS

CaaS

FaaS

Consumer Managed (VM)

Consumer Managed (Container)

Consumer Managed (Code)

Functions

Functions

Functions

App1

App2

App1

App2

Container Engine

Container Engine

Container Engine

Runtime

Runtime

Runtime

Guest OS

Guest OS

Guest OS

Hypervisor

Physical Hardware

CPU

RAM

Disk

NIC

CPU

RAM

Disk

NIC

CPU

RAM

Disk

NIC
# The Big Picture

<table>
<thead>
<tr>
<th></th>
<th>AWS</th>
<th>Azure</th>
<th>Google</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Memory (MB)</strong></td>
<td>64 * k (k = 2, 3, \ldots, 24)</td>
<td>1536</td>
<td>128 * k (k = 1, 2, 4, 8, 16)</td>
</tr>
<tr>
<td><strong>CPU</strong></td>
<td>Proportional to Memory</td>
<td>Unknown</td>
<td>Proportional to Memory</td>
</tr>
<tr>
<td><strong>Language</strong></td>
<td>Python 2.7/3.6, Nodejs 4.3.2/6.10.3, Java 8, and others</td>
<td>Nodejs 6.11.5, Python 2.7, and others</td>
<td>Nodejs 6.5.0</td>
</tr>
<tr>
<td><strong>Runtime OS</strong></td>
<td>Amazon Linux</td>
<td>Windows 10</td>
<td>Debian 8*</td>
</tr>
<tr>
<td><strong>Local disk (MB)</strong></td>
<td>512</td>
<td>500</td>
<td>&gt; 512</td>
</tr>
<tr>
<td><strong>Run native code</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Timeout (second)</strong></td>
<td>300</td>
<td>600</td>
<td>540</td>
</tr>
<tr>
<td><strong>Billing factor</strong></td>
<td>Execution time, Allocated memory</td>
<td>Execution time, Consumed memory</td>
<td>Execution time, Allocated memory, Allocated CPU</td>
</tr>
</tbody>
</table>
Why do we care?

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