
Serverless Academy
Serverless Concepts
Linux Academy Edition

Making the Most of This Course on Linux Academy

- Review the syllabus
- Check out the instructor note cards
- Visit the course community
- Create a course schedule
- Create a study group


Serverless Academy
Serverless Concepts
Course Introduction

About This Course

- Use this as a foundation for future courses
- This course is designed for beginners
- No Labs
- No Cloud Vendor Access Required

Syllabus

- Serverless Definition
  - Backend as a Service
  - Function as a Service
- Comparison of Traditional vs. Serverless Architectures
- Serverless Offerings
  - Cloud Vendors
  - On-Premise Solutions
- Benefits vs. Caveats
- Production Examples
- Ways to Get Started
  - Frameworks


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Serverless Concepts
What is Serverless?

Are There Really No More Servers?

- No, but the implications for developers are pretty similar
- This question has led to tension
- The community has considered renaming “Serverless”
- You lose the ability to get hold of the server and the command line interface (CLI)

Frustration by Peter Alfred Hess
https://flic.kr/p/5x3DF6

We've Been Here Before

- Datacenter operators felt the pressure
  - Infrastructure as a Service (IaaS) caused a shift in responsibility

- Now developers feel the pressure
  - Serverless is causing a shift in responsibility

Pre-Cloud Responsibilities for Dev and Ops

- Budgeting
- Planning
- Connecting
- Powering
- Housing
- Purchasing

- The responsibility process would start all over again to scale

Infrastructure as a Service (IaaS)

- Delivered dramatic improvements in
  - Cost
  - Agility
  - Scalability
  - Reliability, if architected correctly
- Overall Total Cost of Ownership (TCO) fell
- Pricing can be measured in hours
- Application infrastructure can grow and shrink on usage

Going Cloud Native

- (Mobile) Backend as a Service (BaaS)
  - App developers of mobile and single-page web applications started replacing the monolithic server with a distributed system of loosely-coupled components in the cloud
  - Offloaded need to develop and maintain:
    - Identity
    - Authentication
    - Storage
    - Etc.
  - FrontEnd became a delivery vehicle
  - Time-to-market dropped considerably

The Shift Started

- Focus changed:
  - from applications and servers
  - to tasks and process-flows

- Containerization and micro-services became popular

What Serverless Does Not Mean

- Serverless doesn’t mean there are no servers involved
  - Rather, Serverless means developers don’t have to think about the servers
- You offload responsibility to someone else that you trust:
  - Just like when you offload electricity in your home to someone you trust
- Instead you are plugging into elastic computing services
  - Don’t need to provision resources based on load (like IaaS)
  - Don’t need a lot of planning effort (like On-Premise)
  - Growing the app happens on-demand

Serverless Usage is Growing

- This has some auxiliary benefits:
  - Integration skills can apply to multiple projects
  - Hiring Serverless engineers is easier
    - Familiarity with the Application Programming Interface (API) transfers between jobs


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The Game Changer

From Serverless BaaS to Serverless FaaS

- Function as a Service (FaaS)
- AWS Lambda is an implementation of FaaS
- Qualities of a FaaS:
  - Execute logic in response to events
    - In this context, all logic (including multiple functions or methods) are grouped into a deployable unit, known as a “Function”
  - Packaging, deployment, scaling all handled transparently
  - Scaling is handled automatically, assuming the function is stateless

FaaS Use Cases

- Scenarios include:
  - Proxy API credentials
  - Database queries
  - Job dispatching
  - Domain logic

- In all of these, the Function is in charge of executing a task or performing some kind of data extract, transform, load processing

- FaaS makes it easy to write and deploy simple micro-services

Similarities to BaaS

- The front-end (mobile or single-page web app) is still:
  - The delivery vehicle
  - Responsible for coordinating and connecting to these BaaS/FaaS services
- Developers do not have access to the servers that host the back-end
- TCO continues to drop dramatically, even more than with IaaS

Differences to BaaS

- FaaS services are usually priced on time of execution and resource consumption (like allocated RAM)
- BaaS services are usually priced on storage

- FaaS services usually spin up for the length of the execution and then clean themselves up
- BaaS services may be long-running, but that's an implementation detail of the service provider

Is PaaS Serverless?

- Serverless includes BaaS and FaaS but what about:
  - Heroku?
  - Openshift?
  - Elastic Beanstalk?

- No, these are Platform as a Service (PaaS) providers

- PaaS still forces the developer to control the number of instances running, this concern is specifically what Serverless removes

Is This Serverless?

- Firebase
  - Yes, it's a turnkey BaaS provider
- Managed PostgreSQL
  - No, the developer is still responsible for scale
- AWS Lambda
  - Yes, it's a FaaS provider
- AWS DynamoDB
  - Yes, it fits into the BaaS camp, but does not provide all of the APIs that a turnkey BaaS provider has
- AWS Elastic Beanstalk
  - No, it is a PaaS that abstracts the use of underlying IaaS services, but the developer is still responsible for scaling concerns


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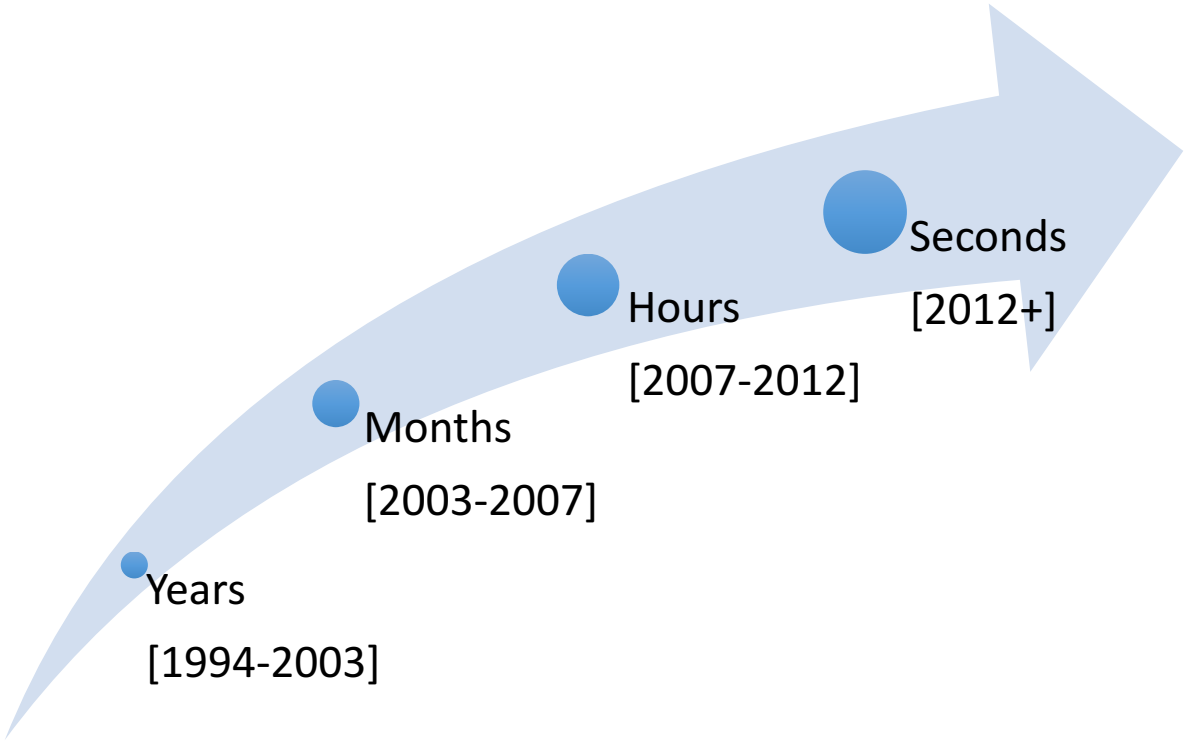
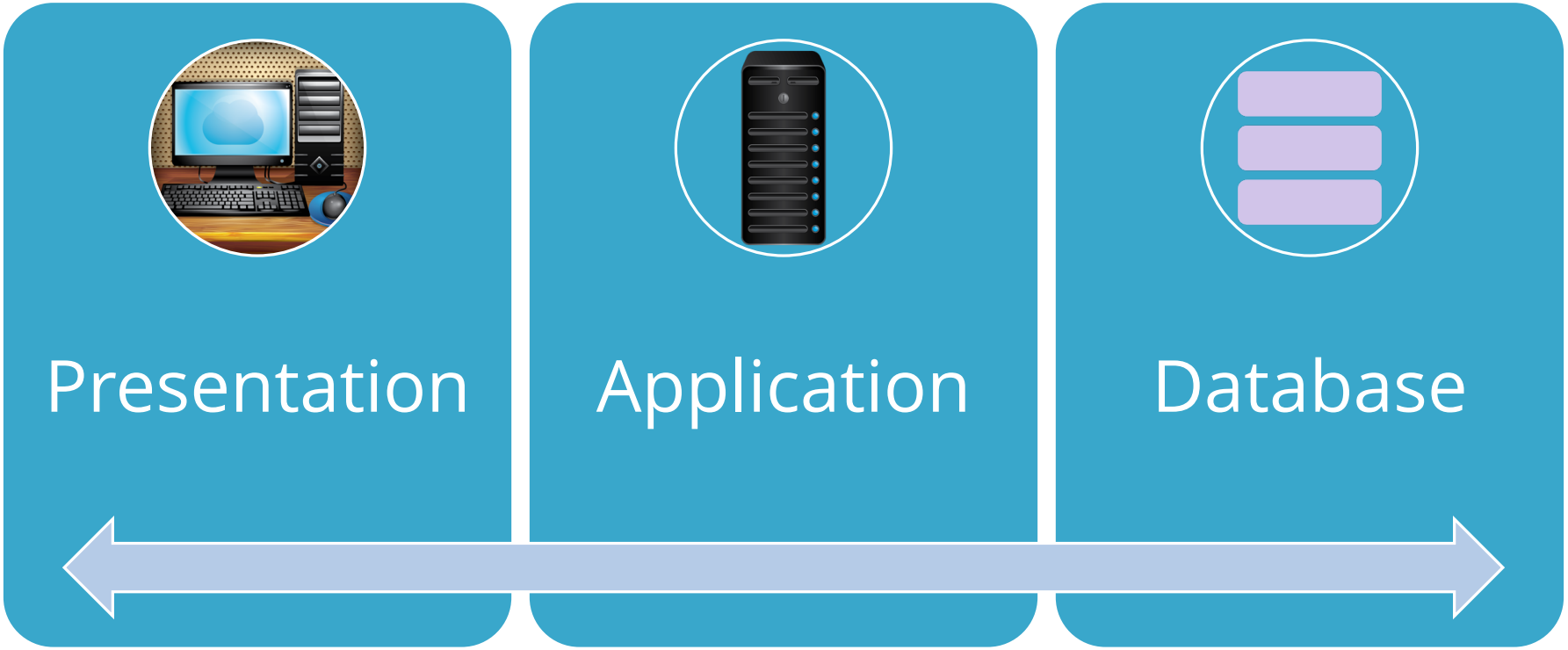
Traditional vs. Serverless Architectures

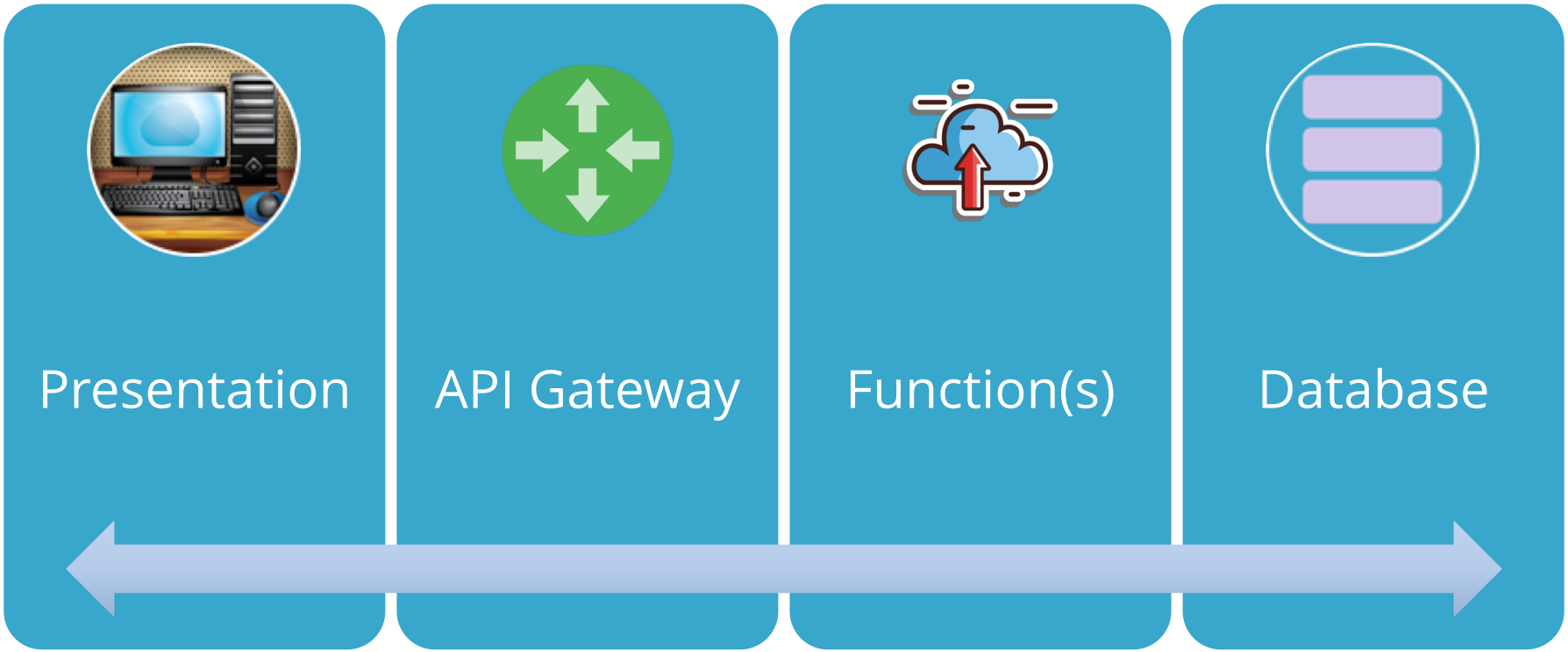
Eras of Provisioning Compute Units



Traditional Client/Server 3-Tier Architecture



Serverless Architecture



Developer Challenges

- Tooling is still very rough around the edges
  - Unless the dev team has strong opinions:
    - Function sprawl can impact
      - Developer workflow
      - Cognitive load
  - Infrastructure as Code best practices still forming

- Writing stateless code can be tricky
  - State is offloaded to a cache or database
  - If function relies on a large dataset, this can be a real challenge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Serverless Offerings:
Google Firebase

Components Used in This BaaS

- Authentication
- Database
- Storage
- Hosting


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Serverless Offerings:
AWS Lambda

Possible Integrations

- Triggers:
  - API Gateway
  - AWS IoT
  - Alexa
  - CloudWatch
  - CodeCommit
  - Cognito
  - DynamoDB
  - Kinesis
  - S3
  - SNS

- All triggers to Lambda come from another AWS entry point

- This could cause concerns about vendor lock-in


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Serverless Offerings:
Azure Functions

Possible Integrations

- HTTP + Webhook
- Event processing
- Timer-based processing
- Stream Analytics


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Serverless Offerings:
IBM Bluemix OpenWhisk


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Serverless Offerings:
AWS API Gateway

What is an API Gateway?

- Thin layer of infrastructure that handles cross-cutting concerns:
  - Key Management
  - Route Definition
  - Request Throttling
  - Basic Caching

- API Gateway is considered serverless because it does not require the developer to be concerned with scale and maintenance


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Serverless Offerings:
On-Premise Options

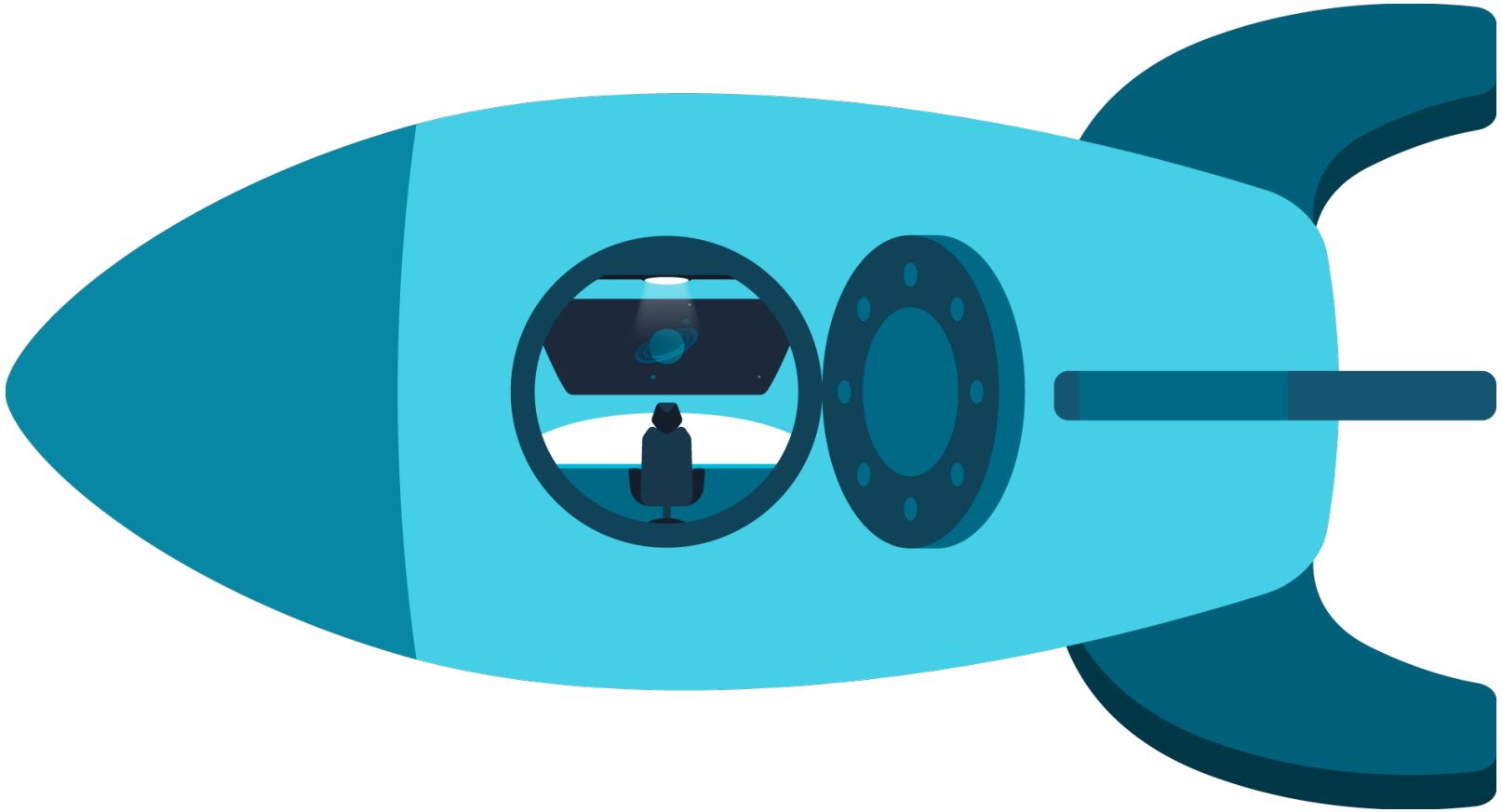
On-Premise Options

- Backend as a Service
  - Parse
- Function as a Service
  - OpenWhisk
  - Gesalt Framework


Parse

OpenWhisk

Gesalt Framework

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Benefits vs. Caveats

Benefits vs. Caveats

- Comparing Benefits and Caveats for:
  - Business
  - Developer
  - User

The Business Perspective: Benefits

- Cost is based on number of function executions, measured in milliseconds instead of hours
- Introduces more agility: Smaller deployable units results in faster delivery of features to the marketplace and increased ability to adapt to change
- Cost of hiring backend infrastructure engineers goes down

The Business Perspective: Caveats

- Less overall control:
  - Vendor lock-in requires more trust for a third-party provider
  - Additional exposure to risk requires more trust for a third-party provider
    - Security risk
    - Disaster recovery risk
  - Cost is unpredictable because number of executions are not predefined

- All of these caveats can be mitigated with open-source alternatives but at the expensive of the cost benefits mentioned previously

The Developer Perspective: Benefits

- No backend infrastructure to be responsible for
- Zero system administration
- Fosters adoption of:
  - Nanoservices
  - Microservices
  - SOA principles
- Faster to get up and running
- No need to worry about number of concurrent requests
- Get some monitoring out of the box

The Developer Perspective: Caveats

- Immature technology results in:
  - Component fragmentation
  - Unclear best-practices
- Discipline required against function sprawl
- Multitenancy means it’s technically possible that neighbor functions could hog the system resources behind the scenes
- Testing locally becomes tricky
- Further limitations:
  - Significant restrictions around local state
  - Execution duration is capped

The User Perspective: Benefits

- If businesses are using that competitive edge to ship features faster, then customers are receiving new features quicker than before

- If the front-end app becomes a data-shipping vehicle:
  - It's possible that users can more easily provide their own storage backend (ie: Dropbox)
  - It's more likely that these kind of apps may offer client-side caching, which provides a better offline experience

The User Perspective: Caveats

- Unless architected correctly, an app could provide a poor user experience as a result of increased request latency


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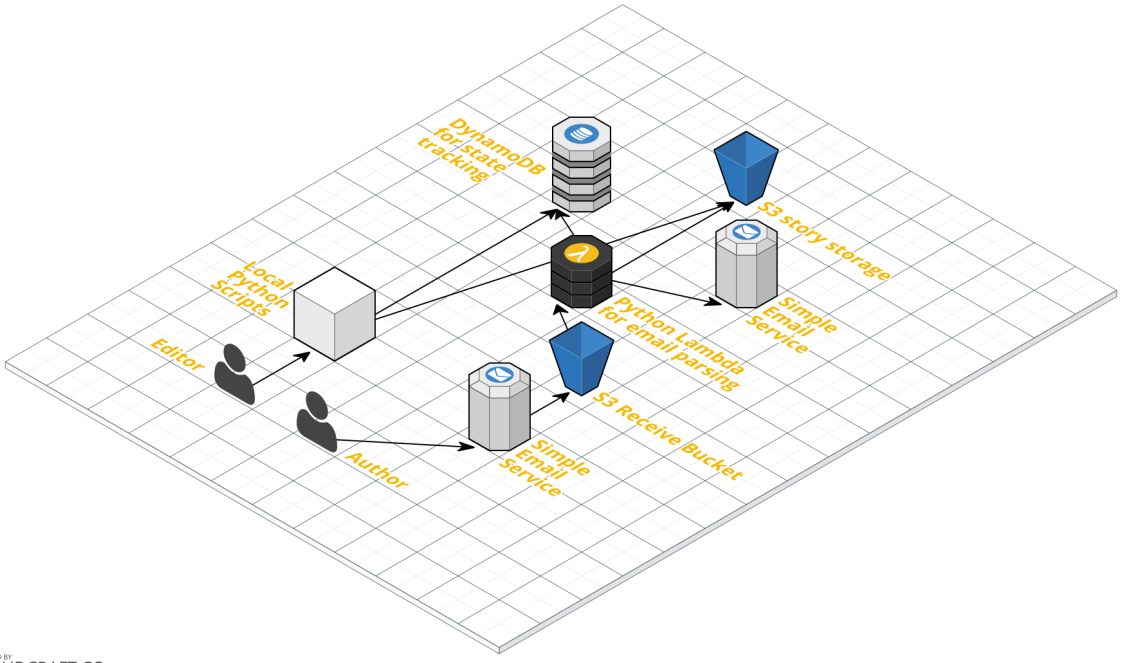
Production Examples

AWS Serverless Application Model (SAM)

- Launched in November 2016
- Extends AWS CloudFormation to define resources for:
  - API Gateway
  - Lambda
  - DynamoDB

Experiences in Production

Experiences in Production



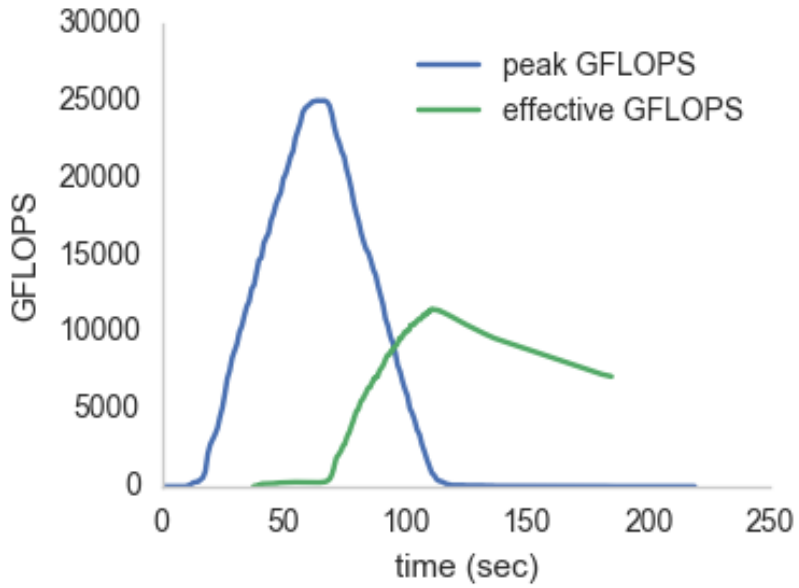
Compelling Science: Lessons Learned

- Run code without managing or provisioning servers
- Charges for compute time that is consumed
- Runs code in discrete chunks
- Takes care of everything required to run/scale with high availability
- Automatically trigger from other AWS services or from web/mobile

- More info: http://compellingsciencefiction.com/blog/2016-11-10.html

Experiences in Production

amplab
UC BERKELEY



AMP Lab: Lessons Learned

- Rate of submitting jobs is slow
- Most jobs start quickly after submission, but variance increases with number of running jobs
- Some jobs finish incredibly quickly, suggested they're running on faster/less-contested hardware

- More info:
  - http://ericjonas.com/pywren.html
  - http://tothestars.io/blog/2016/11/2/serverless-mapreduce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Ways To Get Started

Adoption Paths

- Adoption will look different based on some varying factors:
  - Greenfield or legacy
  - Simple or complex
  - Compliance requirements

- Greenfield projects can pick up a framework and get started
- Legacy projects need to be a little more strategic
  - Evaluate dependencies
  - Apply the Strangler Pattern to your application

Frameworks

- Serverless Framework
- Apex
- ClaudiaJS
- Sparta
- Gordon
- Zappa

Frameworks: Serverless

Frameworks: APEX

Frameworks: Claudia.js

Frameworks: Sparta

Frameworks: Gordon

Frameworks: Zappa