Universitatea "Alexandru Ioan Cuza"
Facultatea de Informatică
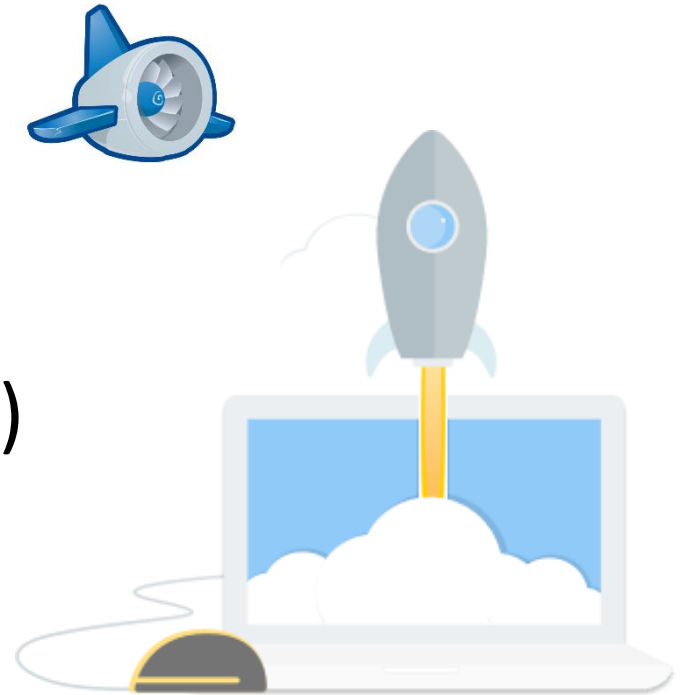
Conf. Dr. Lenuța Alboaie
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Google in Cloud

Cuprins

- Google in Cloud
  - ...pasi
  - Google App Engine
    - Costuri
    - Instrumente (GWT, GAS)
    - Caracteristici
    - Aspecte arhitecturale
    - Servicii
  - Concluzii

Google in Cloud| ...pasi

- ? Google face managementul celor mai mari ferme de servere din lume
- Initial
  - Intreg continutul oferit era disponibil; se baza doar pe suportul oferit de publicitate

  (Servicii: Google Maps, Google Finance, Google Voice)

- Mantra: "*it's free to the consumer*" ☺
  - 15GB pentru stocare per cont + *2GB <-("Check your security settings"*)
  - Google Apps – free hosting pentru serverul de e-mail (cu propriul nume de domeniu), Google Talk, Google Calendar, Google Drive, Google Sites <- Rajen Sheth
  - Google Apps pentru Educatie
  - Urmind modelul Apple: Apps Market- www.google.com/enterprise/marketplace
  - Pentru dezvoltatori: o versiune free de Google App Engine™

  http://code.google.com/appengine
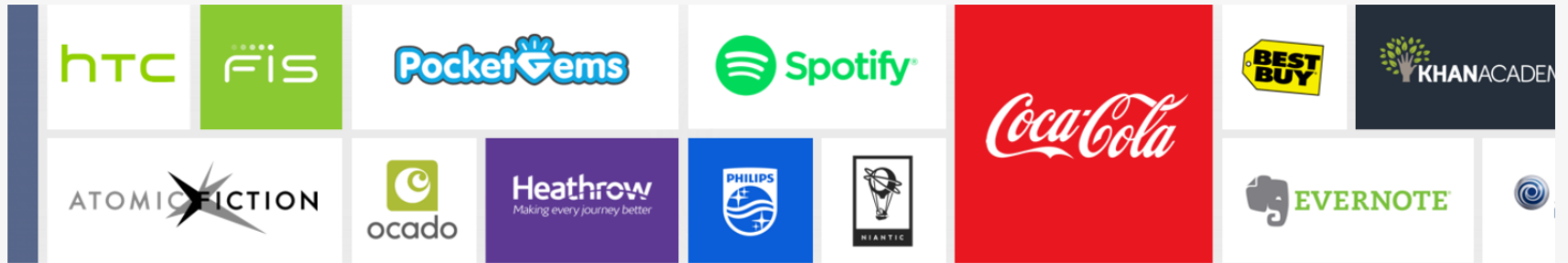
Get your business on Google for free

Google

– Google App pentru Business

Google Cloud Platform Customers

Discover why the world's most innovative organizations are choosing Google Cloud Platform

Get your business on Google for free

WHO'S USING CLOUD PLATFORM?

Over 4 million applications are built on Cloud Platform

GCP FOR STARTUPS PACKAGES

Google

– Google App pentru Business

=>

multi utilizatori
business
(preturi in 2016)

Get your business
on Google for free

Google Apps

$5

per user per month

or $50 per user per year plus tax

Get started

Google Apps for Work includes:

• Business email addresses
  (name@yourcompany.com)

• Video and voice calls

• Integrated online calendars

• 30GB of online storage for file syncing and sharing

• Online text documents, spreadsheets and slides

• Easy to create project sites

• Security and admin controls

• 24/7 phone and email support

Google Apps
with unlimited storage and Vault

$10

per user per month

or $120 per user per year plus tax

Get started

Everything in Google Apps for Work plus:

• Unlimited Storage (or 1TB per user if fewer than 5 users)

• Advanced admin controls for Drive

• Audit and reporting insights for Drive content and sharing

• Google Vault for eDiscovery covering emails, chats, docs and files

• Easily search and export to different formats

• Archive all emails sent by your company

• Set message retention policies

• Place and enforce litigation holds on inboxes

Google

Cloud Price Leader

Google Cloud Platform gives you the best price to performance. Your cloud shouldn't break the bank and compromised performance should never be the only tradeoff.
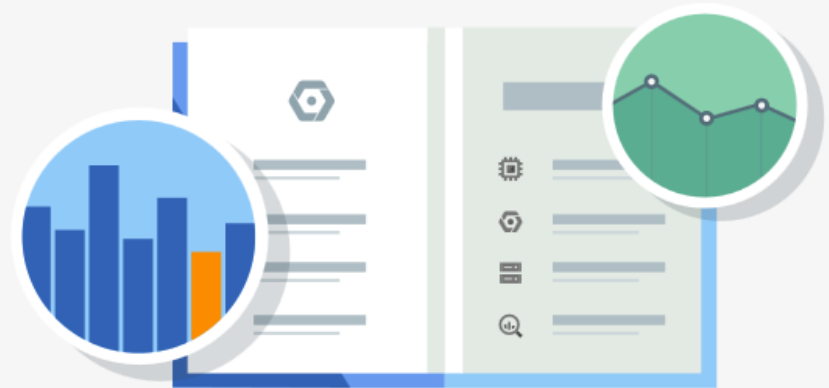
Boot up in
35 seconds

Archive Restore
milliseconds

Milliseconds matter

Google Compute Engine instances boot up in 35 seconds on average. Coldline delivers millisecond data availability for archive restore – other public clouds can take up to 5 hours[1]. Our Local SSDs offer 680,000 IOPS of sustained read performance – some other systems don't reach half of that IOPS. BigQuery can scan up to 35 billion rows, 20 TB of data, in seconds. Price and performance: we have both.
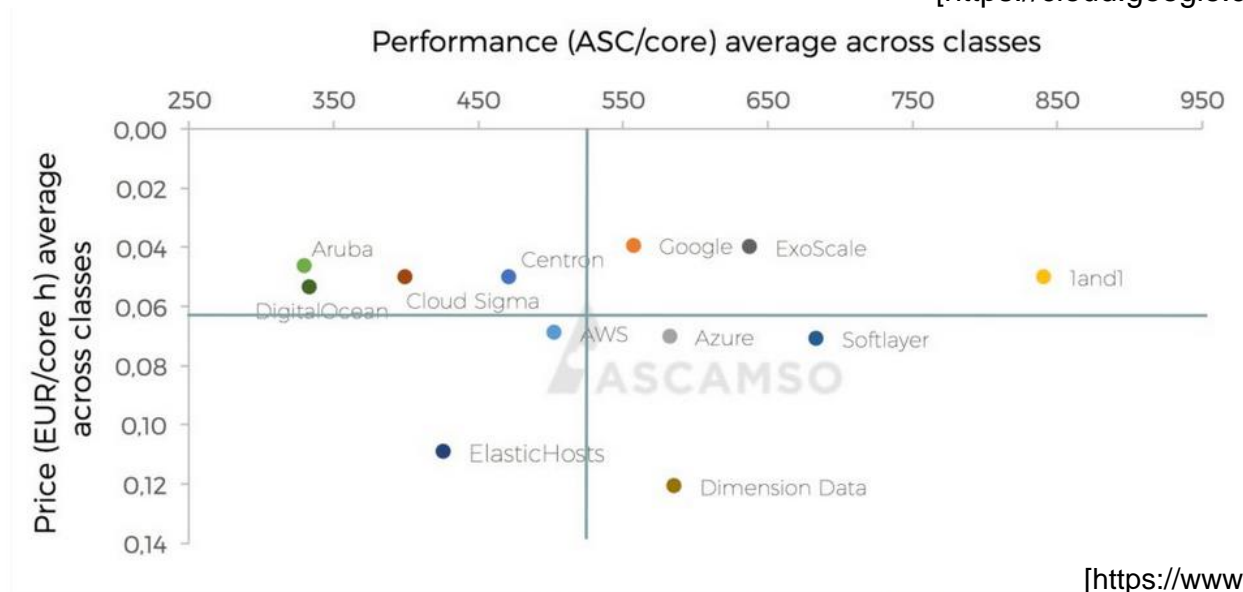
[https://cloud.google.com/pricing/price-leader]

Google

Data center efficiency through DeepMind machine learning

Google has applied artificial intelligence to optimize power usage in Google data centers. The up to 40% reduction in electricity per month needed for cooling is considered a phenomenal step forward in the industry. On average, a Google data center uses 50% less energy than a typical data center.

Up to 50%
Energy Reduction

[https://cloud.google.com/pricing/price-leader]

Performance (ASC/core) average across classes

price performance comparison of providers with European datacenters

[https://www.ascamso.com/905-2/]

Google

Google Web Toolkit – GWT

- http://code.google.com/webtoolkit/gettingstarted.html
- Set de instrumente open-source ce permite dezvoltarea de aplicatii Web complexe
- *"The GWT SDK contains the Java API libraries, compiler, and development server. It lets you write client-side applications in Java and deploy them as JavaScript."*
- *....*
- *"GWT is a development toolkit for building and optimizing complex browser-based applications. Its goal is to enable productive development of high-performance web applications without the developer having to be an expert in browser quirks, XMLHttpRequest, and JavaScript. GWT is used by many products at Google, including AdWords, AdSense, Flights, Hotel Finder, Offers, Wallet, Blogger. It's open source, completely free, and used by thousands of developers around the world."*
- *....*

Google

Google Apps Script - https://developers.google.com/apps-script/

- Ofera posibilitatea automatizarii procesului de business, prin intermediul unor scripturi ce aduc un plus de functionalitatea fata de suita de aplicatii deja existente

    - Legatura aplicatiilor Google cu servicii *third party*: un script poate trimite email-uri si o invitatie unei liste dintr-o baza de date MySQL

    - Crearea de functii specializate pentru spreadsheet-uri: realizarea de analize complexe asupra datelor din Google spreadsheets

    - Construirea unei interfete utilizator atractiva: o aplicatie interna dintr-o companie poate beneficia de o interfata construita cu GAS

"With Apps Script, you can create add-ons for Google Sheets, Docs, or Forms, automate your workflow, integrate with external APIs, and more. "

11 Google apps, 1 platform in the cloud

Increase the power of your favorite Google apps — like Calendar, Docs, Drive, Gmail, and Sheets. Apps Script lets you do more with Google. All on a JavaScript platform in the cloud.

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Google Cloud Platform

Hosting + Compute

App Engine

Compute Engine

Storage

Cloud Storage

Cloud Datastore

Cloud SQL

Big Data

BigQuery

Services

Cloud Endpoints

Translate API

Prediction API

2015 - https://cloud.google.com/

Google Cloud Platform

Compute	Storage	Big Data	Services
App Engine	Cloud Storage	BigQuery	Cloud Endpoints
Compute Engine	Cloud Datastore	Cloud Dataflow	Translate API
Container Engine	Cloud SQL	Cloud Dataproc	Prediction API
	Cloud Bigtable	Cloud Pub/Sub	

2016 - https://cloud.google.com/

Google Cloud Platform

Compute >	Storage & Databases >	Networking >
Big Data >	Machine Learning >	Identity & Security
Management Tools >	Developer Tools >	

2017 - https://cloud.google.com/

Google Cloud Platform

2017 - https://cloud.google.com/

Google Cloud Platform

2017 - https://cloud.google.com/docs/overview/

Google App Engine| *Hosting & Compute*

Compute Engine

Run large-scale workloads on virtual machines hosted on Google's infrastructure. Choose a VM that fits your needs and gain the performance of Google's worldwide fiber network.

Compute	>
Compute Engine Run VMs on Google's infrastructure	>
App Engine PaaS for apps and backends	>
Container Engine Run containers on GCP	>
Container Registry Private container image storage	>
Cloud Functions BETA Serverless environment to build and connect cloud services	>

- https://cloud.google.com/compute/
- Facilitati:
  - *High-performance virtual machines* (Debian, CentOS <–> instante: microVM -> large)
  - Comunicare**:** *Google's private global fiber network*
  - *pay-per-use* – Obs. "*Google bills in minute-level increments … (after 10 minutes minimum charge*)"
  - Management automat si facil (API RESTful, command-line interface, etc)
  - Securitate: Certificari pentru Google Compute Engine: ISO 27001, SSAE-16, SOC 1, SOC 2, si SOC 3

Google App Engine| *Hosting & Compute*

2017| Cloud Computing – http://www.info.uaic.ro/~adria

Google App Engine | Storage

- https://cloud.google.com/storage/
- Facilitati:
  - Standard Storage – util pentru stocarea de date care necesita latenta mica
  - Durable Reduced Availability (DRA) – util pentru stocare de date senzitive, dar se permite un nivel de indisponibilitate
  - Nearline Storage (Beta) – pentru stocare de date *long-lived* dar care sunt accesate mai putin frecvent

Google App Engine | Storage

Cloud Datastore

Use a managed, NoSQL, schemaless database for storing non-relational data. Cloud Datastore automatically scales as you need it and supports transactions as well as robust, SQL-like queries.

- https://cloud.google.com/datastore/
- Facilitati:
  - Serviciu de stocare *schemaless*
  - Permite replicare si sharding automat => disponibilitate si consistenta
  - Tranzactii ACID
  - Cloud Datastore Development Kit – permite dezvoltarea locala de aplicatii

Google App Engine | Storage

Cloud SQL

Store and manage data using a fully-managed, relational MySQL database. Google handles replication, patch management and database management to ensure availability and performance.
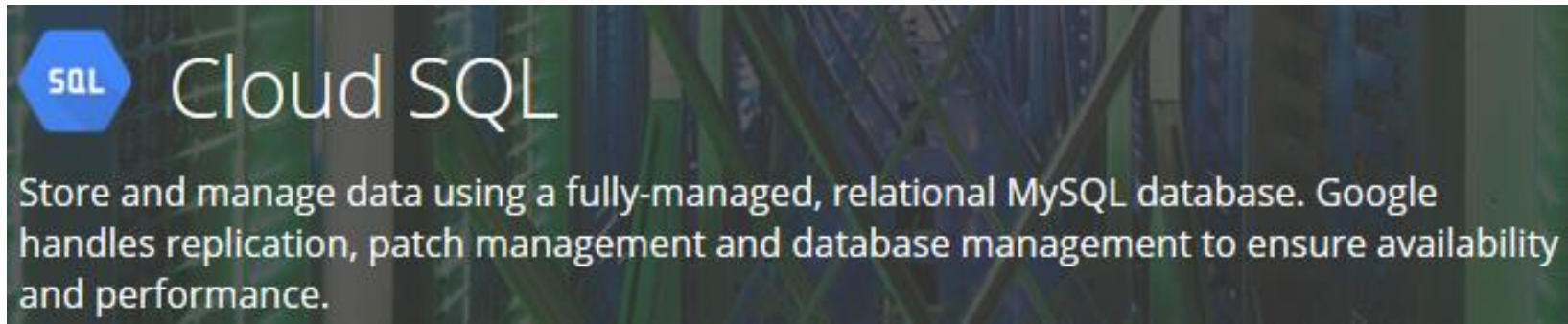
- https://cloud.google.com/datastore/
- Facilitati:
  - Baze de date MySQL
  - Se asigura securitatea (ISO/IEC 27001) si disponibilitate
  - Acces: consola Web sau interfata in linia de comanda
  - *No Lock-in*

Google App Engine | Big Data

BigQuery

Analyze Big Data in the cloud with BigQuery. Run fast, SQL-like queries against multi-terabyte datasets in seconds. Scalable and easy to use, BigQuery gives you real-time insights about your data.

- https://cloud.google.com/bigquery/
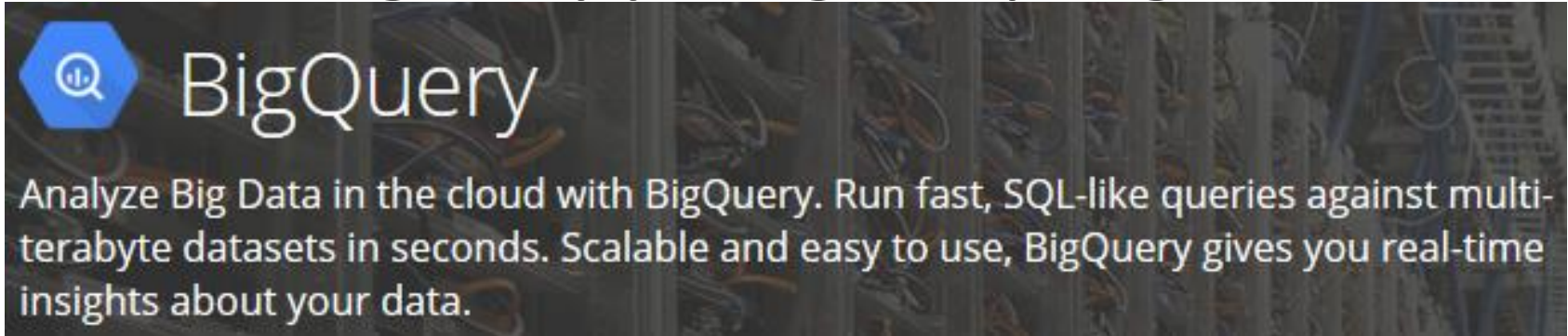
- 1TB/luna de date este free

- Interogarile se pot executa in mod asincron in background; se permite accesul la istoria interogarilor si job-urilor

Resource	Pricing
Loading Data	Free
Exporting Data	Free
Storage	$0.020 per GB / month[1,4]
Interactive Queries	$5 per TB processed[2,3,4]
Batch Queries	$5 per TB processed[2,3,4]
Streaming Inserts	$0.01 per 100,000 rows.

Google App Engine | Big Data

BigQuery

Analyze Big Data in the cloud with BigQuery. Run fast, SQL-like queries against multi-terabyte d... real-time insights a...

Language correlation

Top 10 repos by total number of forks

Token occurrence per language

Search for the number of occurrences of a token across all commits per language:

hello

Send request

```
1  SELECT repository_language, COUNT(*) AS cntlang
2  FROM [githubarchive:github.timeline]
3  WHERE repository_language != ''
4  AND payload_commit_msg != ''
5  AND PARSE_UTC_USEC(created_at) > PARSE_UTC_USEC('2014-03-09
6  AND REGEXP_MATCH(payload_commit_msg,
7   r'(?i)\b(hello)\b')
8  GROUP BY repository_language
9  ORDER BY cntlang DESC
```

Query complete: 2.5s elapsed

Language	Count
JavaScript	14989
Java	12000
CSS	9076
Ruby	8661

Google Cloud| Services

Cloud Endpoints

Create RESTful services and make them accessible to iOS, Android and Javascript clients. Automatically generate client libraries to make wiring up the frontend easy. Built-in features include denial-of-service protection, OAuth 2.0 support and client key management.

- Ofera biblioteci in Java, Python, Go si PHP pentru construirea de aplicatii pentru Android, iOS sau clienti web

Translate API

Quickly and dynamically translate between thousands of available language pairs within your app, integrating with Google Translate.

Prediction API

Use Google's machine learning algorithms to analyze data and predict future outcomes using a familiar RESTful interface.

Google App Engine

2008 – lansarea GAE - http://www.youtube.com/watch?v=3Ztr-HhWX1c&feature=youtu.be

App Engine

Run your applications on a fully-managed Platform-as-a-Service (PaaS) using built-in services that make you more productive. Just download the SDK and start building immediately.

[https://developers.google.com/appengine/training/intro/whatisgae]
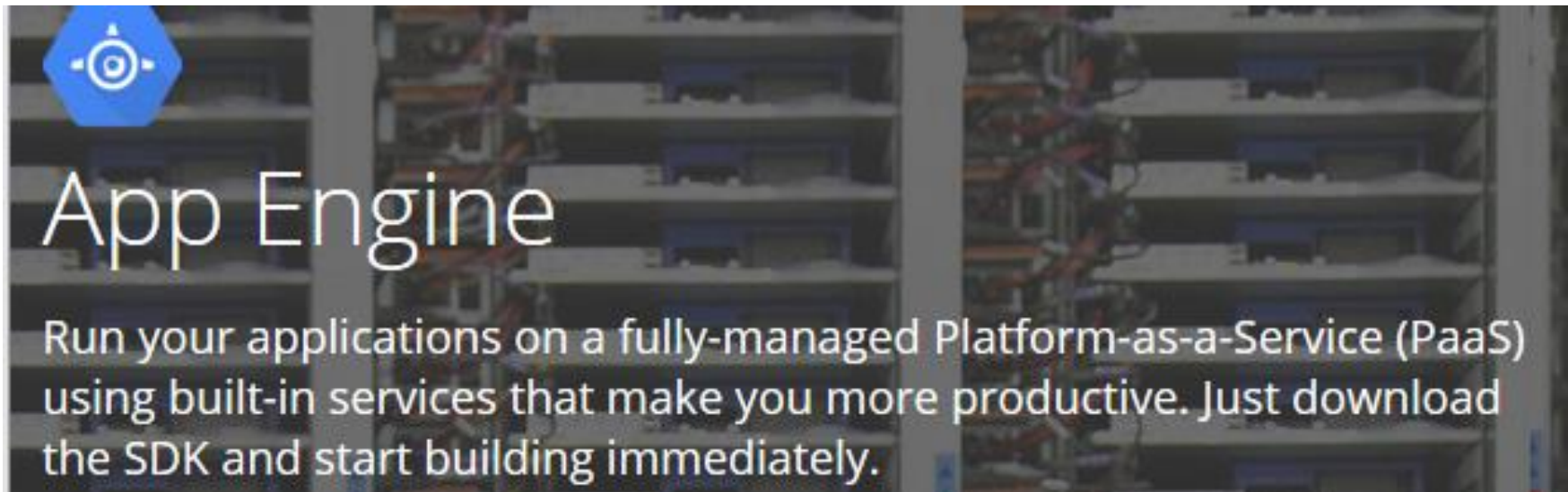
Google App Engine

Google App Engine

- 2017|Mediul de dezvoltare App Engine ofera

Standard Environment

    About the Standard Environment

    Python 2.7

    Java 7

    PHP 5.5

    Go 1.6

Flexible Environment

    About the Flexible Environment

    Python 2.7, 3.5

    Java 8

    Node.js

    Go 1.8

    Ruby

    PHP 5.6, 7

    .NET

    Custom Runtimes

    Known Issues

[https://cloud.google.com/appengine/docs/]

Google App Engine

Google App Engine

- Mediul de dezvoltare App Engine ofera:

  - **App Engine Standard Environment - *Sandbox Environment*** – cod + server Web+ *language runtime (modificat)* a.i. se respecta restrictiile *sandbox* => aplicatiile ruleaza intr-un mediu securizat, izolat de nivelul hardware, sistemul de operare si localizarea fizica a serverului

    - Aceasta limitare permite distribuirea cererilor web la mai multe servere web (pornirea/oprirea lor) in functie de cresterea/scaderea cererilor

  - **App Engine Flexible Environment** – permite rularea de aplicatii App Engine folosind ***Google Compute Engine***

    - *"VM hosting environment offers more flexibility and provides more CPU and memory options".*
    - Nu mai exista restrictiile din *sandbox runtimes*
      [https://cloud.google.com/appengine/docs/] 25

Feature	Flexible environment	Standard environment
Instance startup time	Minutes	Milliseconds
Maximum request timeout	60 minutes	60 seconds
Background threads	Yes	Yes, with restrictions
Background processes	Yes	No
SSH debugging	Yes	No
Scaling	Manual, Automatic	Manual, Basic, Automatic
Writing to local disk	Yes, ephemeral (disk initialized on each VM startup)	No
Modifying the runtime	Yes (through Dockerfile)	No
Automatic in-place security patches	Yes (excludes container image runtime)	Yes
Network access	Yes	Only via App Engine services (includes outbound sockets)
Supports installing third-party binaries	Yes	No
Location	North America or Asia Pacific. The flexible environment is not supported in Europe.	North America, Asia Pacific, or Europe
Pricing	Based on usage of vCPU, memory, and persistent disks	Based on instance hours

[https://cloud.google.com/appengine/docs/the-appengine-environments] 26

Google App Engine

App Engine Flexible Environment

- Folosind Serviciile Google Compute Engine, App Engine asigura automat:
  - scalarea si *load balancing*
  - verificarea starii instantelor si co-locarea optima alaturi de alte servicii din proiect
  - se ofera acces de root la instantele Compute Engine VM (accesul ssh este dezactivat in mod implicit)
  - suport pentru update-uri
  - se permite modificarea *environment-ului* si a sistemului de operare prin utilizarea *Dockerfiles*
- Sunt suportate nativ: *microservices, authorization, SQL and NoSQL databases, traffic splitting, logging, versioning, security scanning,* si *content delivery networks*

Google App Engine

App Engine Flexible Environment

– **Runtimes**

Google-supplied Dockerfile => standard runtime

- *ofera suport nativ pentru:* Java 8 / Servlet 3.1 / Jetty 9, Python 2.7 and Python 3.5, Node.js, Ruby, PHP, .NET core, and Go
- *Nu exista restrictii* sandbox
- *Se pot face interogari privind starea VM, se ofera suport pentru servicii ca: Datastore,   Memcache, Task Queues, Logging, Users*

Docker image sau Dockerfile modificat (open source) => custom runtime

- *Se foloseste daca se doreste scrierea de cod in alte limbaje*
- *Se pot configura componente ca: interpretoare sau servere de aplicatii*

– **Performanta**

- O gama larga de configuratii ale CPU si memoriei care odata configurate vor fi furnizate de AppEngine in mod automat

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Google App Engine

- **App Engine Flexible Environment**

https://cloud.google.com/appengine/docs/flexible/

GO	JAVA 8	PHP 5 / 7	PYTHON 2.7 / 3.5
.NET	NODE.JS	RUBY	CUSTOM RUNTIMES

Google App Engine

- **App Engine Flexible Environment - NodeJS**

https://cloud.google.com/appengine/docs/flexible/nodejs/

The App Engine flexible environment is based on Google Compute Engine and automatically scales your app up and down while balancing the load.

Quickstart
Deploy your first app

How-to Guides
Perform specific tasks

APIs & Refere...
API and App Engine Gloss...

Concepts
Develop a deep understanding of Node.js flexible environment

Tutorials
Walkthroughs of common applications

Resources
Pricing, quotas, release notes, and other resources
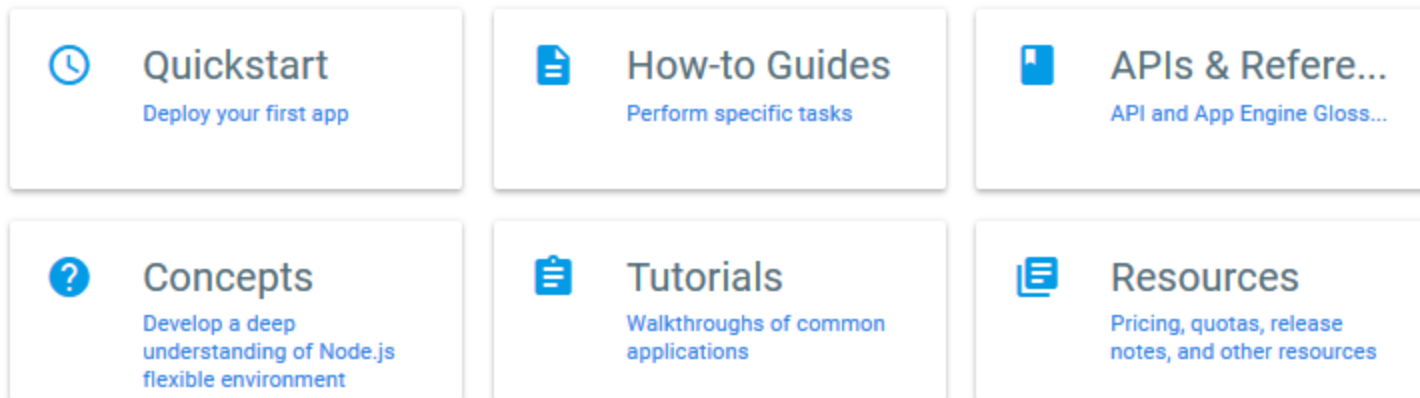
Google App Engine

- **App Engine Flexible Environment or Standard Environment**

- Source code that is written in a version of any of the supported programming languages:
  Python, Java, Node.js, Go, Ruby, PHP, or **.NET**

- Runs in a Docker container that includes a custom runtime or source code written in **other programming languages**.

- **Depends on other software, including operating system packages** such as imagemagick, ffmpeg, libgit2, or others through apt-get.

- Uses or depends on frameworks that include **native code**.

- Accesses the resources or services of your Cloud Platform project that reside in the **Compute Engine network**.

- Source code is written in **specific versions of the supported programming languages**:
  - Python 2.7
  - Java 7
  - PHP 5.5
  - Go 1.6

- Intended to **run for free or at very low cost**, where you pay only for what you need and when you need it. For example, your application can scale to 0 instances when there is no traffic.

- Experiences **sudden and extreme spikes of traffic** which require immediate scaling.

[https://cloud.google.com/appengine/docs/the-appengine-environments]

Google App Engine

- O aplicatie poate contine module care ruleaza in medii de gazduire diferite e.g se poate folosi pentru frontend *sandbox* si pentru procesare sa se foloseasca **App Engine Flexible Environment**
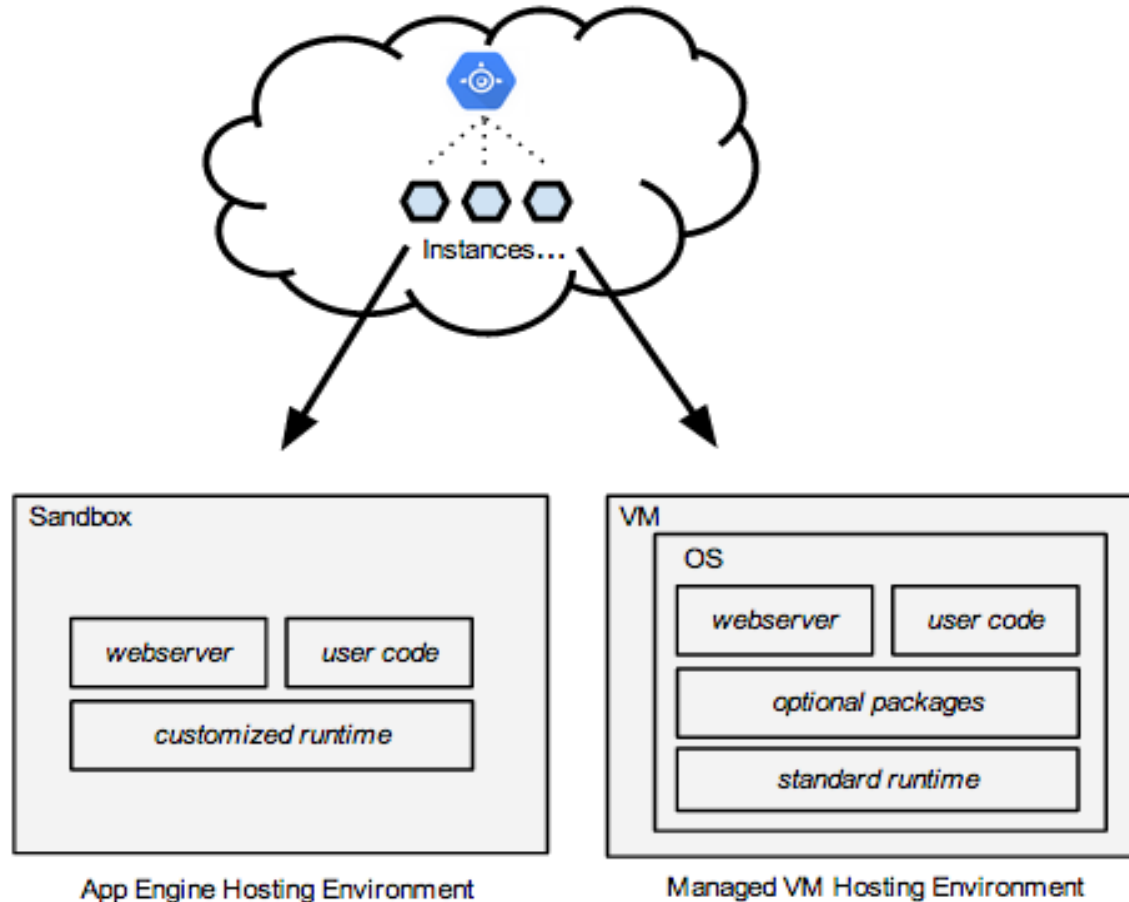
Google App Engine | Standard Environment

"Some users confuse Google App Engine with Amazon's EC2 service. The problem is that this is an apples to oranges comparison. Both operate at different cloud service levels, and each have their strengths and minuses. With App Engine, you only need to worry about your application and let Google take care of hosting and running it for you. With EC2, you're responsible for the app, but also its database server, web server, operating system, monitoring, load-balancing, upgrades, etc. This is the reason why typically, the costs for IaaS services run lower than that of PaaS services because with PaaS, you're "outsourcing" more work/responsibility. Cost estimates usually clouded by not considering the administration overhead when managing the infrastructure yourself. A better "apples-to-apples" comparison would be EC2 to the [Google Compute Engine](#) IaaS service."

[https://developers.google.com/appengine/training/intro/whatisgae]

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Google App Engine | Standard Environment

App Engine Standard Environment

Caracteristici

- Permite rularea (*hosting*) de aplicatii Web folosind infrastructura Google
  - *"App Engine Does One Thing Well"* [Rossum, Google]
- A nu se intelege *"rent a piece of a server"*, deoarece aplicatia nu este gazduita pe un singur server
- Conceptual Google App Engine este la nivel PaaS
- Controlul?
  - Il are Google…
  - Fara griji legate de infrastructura, *load balancing,* managementul stocarii
- Folosind Google Apps aplicatia poate folosi propriul domeniu (http://www.ex.com) sau poate folosi un nume din domeniul *appspot.com*

Google App Engine | Standard Environment

Caracteristici

- GAE suporta aplicatii scrise in diferite limbaje (vezi slide-urile urmatoare)

- Dezvoltatorii au acces la tehnologii de stocare de tipul GFS (Google File System), Bigtable (sistem de stocare pentru date nestructurate),...

- "*With Google App Engine, developers can write Web applications based on the same building blocks that Google uses,*" Kevin Gibbs, Google's technical lead for the project, wrote in *The Official Google Blog. "Google App Engine packages those building blocks and provides access to scalable infrastructure that we hope will make it easier for developers to scale their applications automatically as they grow.*"

Google App Engine | Standard Environment

Need not to purchase

Hosting service

Need not to build data center

Free domain name service

Scalability

Pay as you go

Need not to manage

Easy to initial

Google App Engine | Standard Environment

Cloud Applications

Cloud Software Environment

Cloud Software Infrastructure

Computational Resources

Storage

Communications

Software Kernel

Firmware / Hardware

Google App Engine | Standard Environment

HTTP / HTTPS

URL fetch or E-mail

Browser

Web interface

Request

Sandbox

Runtime environment

transactions

Datastore Memcache

Response

Result

Web page

Schedule routine

More services

Static Storage

Google App Engine | Standard Environment

Browser

Web interface

Web page

Request

Response

HTTP / HTTPS

URL fetch or E-mail

Sandbox

Runtime environment

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transactions

Result

Datastore Memcache

More services

Static Storage

Google App Engine | Standard Environment

Application Standard Environment - Sandbox

- Aplicatiile ruleaza intr-un mediu sigur, dar care asigura un acces limitat la sistemul de operare

- Este independent de nivelul hardware, sistem de operare sau localizarea fizica a serverului Web

- Aplicatiile nu pot scrie in sistemul de fisiere, pot doar citi ceea ce s-a incarcat prin codul aplicatiei

Google App Engine | Standard Environment

Application Standard Environment

Mecanism:

- La primirea cererii, AppEngine selecteaza serverul estimat ca fiind cel mai rapid, trimite cererea la aplicatie si returneaza clientului raspunsul

- Obs. Nu se pastreaza starea intre cereri => AppEngine asigura acelasi tratament tuturor cererilor, prin distribuirea traficului intre servere

- Aplicatiile pot accesa doar propriile fisiere din sistemul de fisiere, si nu ale altor aplicatii;

- Aplicatiile pot vedea variabilele de mediu setate de AppEngine dar manipularea acestora nu este neaparat persistenta intre cereri
  - Aplicatia trebuie sa foloseasca *GAE Datastore* pentru a asigura persistenta intre cereri

Google App Engine | Standard Environment

Application Standard Environment

- Aplicatiile nu pot accesa facilitatile de retea la nivel hardware, dar se permite realizarea de operatii de retea prin utilizarea serviciilor

- O aplicatie poate accesa alte computere doar prin serviciu de email sau *URL fetch*

  - cereri HTTP(HTTPs) folosind porturile standard

  - are limitari privind utilizarea CPU, a memoriei consumate per cerere

    - la o cerere se poate raspunde intr-un timp de pana la 60 de secunde

  - Obs. App Engine este optimizat pentru aplicatii care raspund in mai putin de o secunda

  - Daca aplicatia utilizeaza mai multi cicli de procesor, App Engine o va incetini pentru a nu fi afectate performantele celorlalte aplicatii care ruleaza pe aceeasi masina

Google App Engine | Standard Environment

Application Standard Environment

- Obs. Mediul Python 2.7 permite citirea, scrierea si modificarea *bytecode*

- **Python runtime**
  - Se foloseste o versiune a interpretorului cPython
  - Mecanism general: App Engine invoca o aplicatie Python folosind CGI
  - Framework-uri Python cum ar fi Django, web2py, Pylons functioneaza cu App Engine
    - AppEngine include si un framework propriu Python
  - 8 martie 2013, se ofera doar suport pentru Python 2.5 (*deprecated*) http://googleappengine.blogspot.ro/2013/03/python-25-thanks-for-good-times.html)

Google App Engine | Standard Environment

Application Standard Environment

– **GAE Java runtime environment**

  - Aplicatiile Java poate fi dezvoltate folosind Java 7 JVM

  - Se pot construi aplicatii apeland la tehnologii Java standard (servleturi Java, JavaServer Pages (JSPs),…)

  - https://cloud.google.com/appengine/docs/java/

– **Go Runtime**

  - Ruleaza versiune de Go 1.6

  - SDK include compilatorul Go si librariile standard

  - Se furnizeaza un GoAPI pentru majoritatea serviciilor App Engine (Storage, Schedule, Communication, ….)

  - Se pot folosi biblioteci *thirt-party*, conditia e ca acestea sa fie implementate doar in Go

  - https://cloud.google.com/appengine/docs/go/

Google App Engine | Standard Environment

Application Standard Environment

- **PHP runtime environment**

Se creaza aplicatia folosind *sandboxed PHP 5.4 environment*

- App Engine PHP SDK include: server web pentru testarea PHP locala; serverul simuleaza serviciile AppEngine (inclusiv versiune locala a Google Accounts si abilitatea de a trimite mailuri de pe computerul local folosind App Engine API)
- Obs. Este nevoie de Python 2.7, deoarece serverul de dezvoltare este o aplicatie Python
- Exista SDK pentru platforme ca: Linux, MacOS, Windows

- Se integreaza aplicatia App Engine cu Google Accounts pentru autentificare
- PHP runtime contine un wrapper ce permite accesul facil la servicile oferite de Google Cloud Storage

https://cloud.google.com/appengine/docs/php/

Google App Engine | Standard Environment

Application Standard Environment

- Aspecte privind invocarea unei aplicatii:

  – Mecanism: cererea este rutata la server, aplicatia este pornita, se creaza raspunsul, raspunsul este returnat clientului

  – Fiecare mediu ruleaza propriul interpretor (JVM sau Python) respectind restrictiile *sandbox* (e.g. incercarea de a folosi vre-o facilitate a limbajului sau a librariilor existente, care sa acceseze alte resurse decat cele permise va conduce la o exceptie)

  – Utilizarea pentru fiecare cerere a unui server diferit

    => avantaj: scalare

    => dezavantaj: este consumatoare de timp operatia de crea o instanta per fiecare cerere

    Solutie:

      - AppEngine atenuiaza costurile de pornire prin mentinerea aplicatiei in memoria serverului, maxim posibil si reutilizarea inteligenta a serverelor

      - toate serverele au mediile *runtime* preincarcate inainte ca cererea sa ajunga la server

Google App Engine | Standard Environment

HTTP / HTTPS

URL fetch or E-mail

Browser

Web interface

Request

Sandbox

Runtime environment

transactions

Datastore Memcache ...

Respon se

Web page

Result

Schedule routine

More services

Static Storage

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Google App Engine | Standard Environment
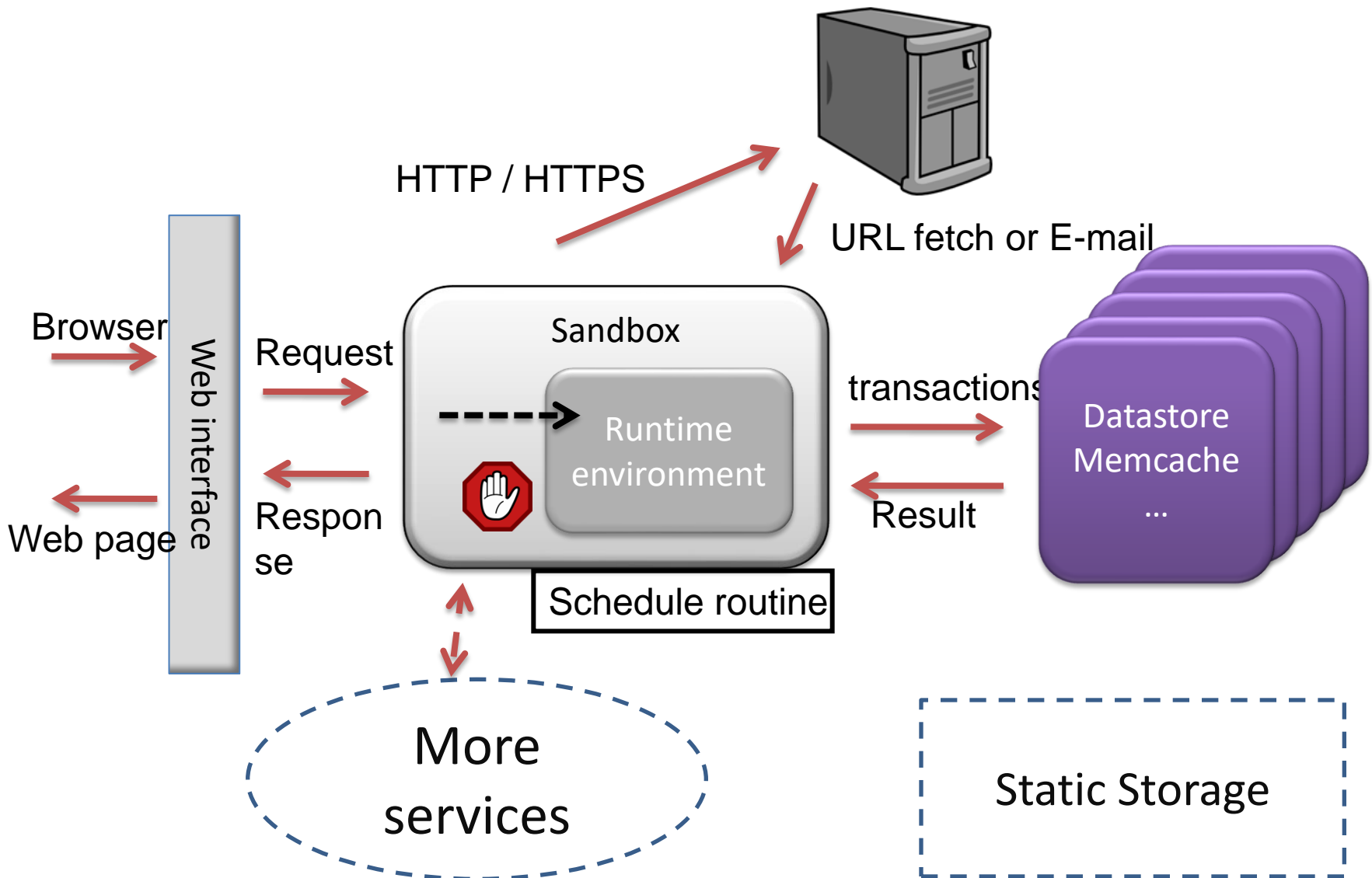
Storage Services

- **Static**
  - Spatiu static (fisiere sursa a serviciilor Web, fisiere de configurare, imagini de background,….)
  - Blobstore
    - Contine fisiere mai mari de 1MB (imagini, video sau audio, etc)
- **Dinamic**
  - Datastore
    - Fiecare entitate nu depaseste 1MB
    - Serviciu furnizat in maniera "dynamic provisioning" ce suporta operatii dinamice de inserare/update/delete a datelor
  - Memcache
    - Folosit pentru a creste viteza interogarilor din datastore

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Static File Servers

– Multe site-uri web dispun de resurse care nu sufera schimbari in timpul operatiilor obisnuite asupra site-ului (e.g. imagini, fisiere CSS, cod JavaScript, pagini HTML cu continut static)

  • Sunt denumite *static files*

    – Furnizarea acestor resurse nu implica cod de aplicatie => nu necesita servere de aplicatii

    – AppEngine furnizeaza servere dedicate care furnizeaza acest tip de continut - **Static File Servers**

– Pentru clientul final o astfel de resursa statica este similara cu orice alta resursa

– Dezvoltatorii pot configura cateva aspecte privind modul de furnizare al resurselor statice (URL-uri, content types, instructiuni pentru browsere pentru a mentine copii ale fisierelor in cache, etc.)

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Storage Services

- **Blobstore**
  - *Binary large objects* – care sunt de dimensiune mai mare decat dimensiune permisa pentru obiectele din serviciul datastore (video, img,...)
  - Sunt create prin incarcarea de fisiere ca rezultat al cererilor HTTP

Text

Blobstore

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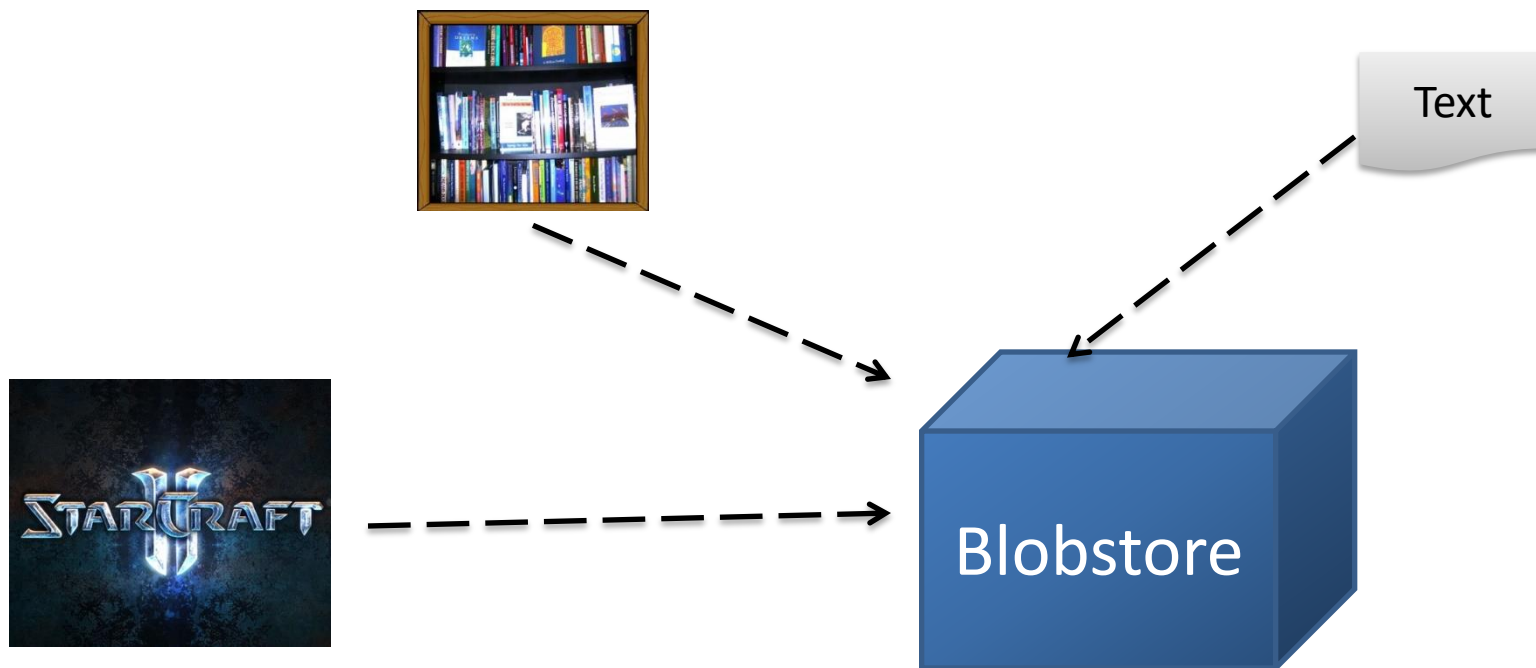
Storage Services

Datastore

– O aplicatie AppEngine stocheaza datele intr-una sau mai multe entitati de stocare (*datastore entities* sau *data objects)*

– *Entitatea* are asociate *properties* de tipul *name – value*

Status:= awake

Name:= Hamsa

photo

Age:= 1

Weight := 3 KG

entity := Dog

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Storage Services

Datastore

- Proprietatile pot avea un anumit *tip*
- Constructorul proprietatii poate defini
  - Numele
  - Valoarea implicita
  - O lista de valori
  - ...

Properties: Text, Blob, ...etc, List, Date/Time, E-mail, Boolean, Integer, String
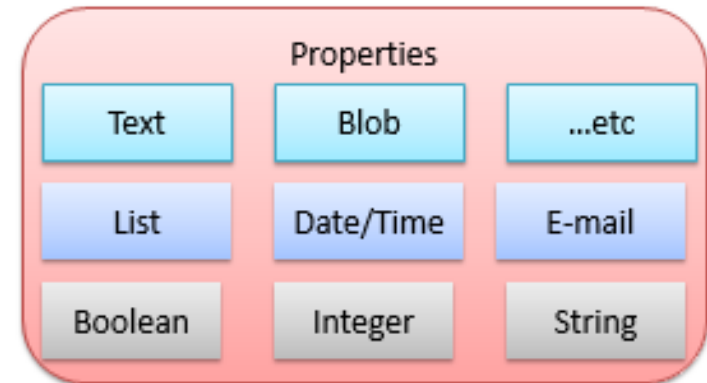
```
from google.appengine.ext import db
class Dog(db.Model):
        name    = db.StringProperty(default='dog')
        age     = db.IntegerProperty(required=True)
        weight  = db.IntegerProperty(indexed=False)
        status  = db.StringProperty( choices = ['awake', 'eat', 'play']
)       photo   = db.BlobProperty()
```

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Storage Services

Datastore

– O entitate are o **cheie unica (*key*)** care e furnizata de aplicatie sau de App Engine (dezvoltatorul decide)

- Aceasta cheie nu este o proprietate elementara, ci este un aspect independent al entitatii
- O cheie nu poate fi schimbata dupa ce entitatea a fost creata
- Cunoscand cheia, se pot face interogari

– Cunoscand tipul entitatii si cheia asociata se poate determina unde este entitatea stocata in intreaga colectie de servere

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Storage Services

Datastore

- Operatii:
  - *put(key)* – *upload* sau *update*
  - *delete(key)* – stergerea unei entitati
  - *get (key) , ...*
- ? Similitudine cu baze de date relationale (... ? *entities = rows* din tabele; ?*properties = columns*)
  - Diferente:
    - O entitate de un anumit tip poate avea proprietati diferite fata de o alta entitate de acelasi tip
    - O entitate poate avea o proprietate cu acelasi nume dar de tip diferit, fata de o alta entitate de acelasi tip ca ea
  - => entitatile din *datastore* sunt *schemaless* => flexibilitate marita & provocari in mentenanta

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Interogari si indexari

- Datastore foloseste *indexes* pentru fiecare interogare facuta de aplicatie
- Exemple de tipuri de interogari:
  - Dupa proprietatile entitatii si se va obtine lista entitatilor ordonate dupa valoarea proprietatii
  - Filtrare si sortare dupa chei

Interogari si indexari

– Mecanism intern de executie a interogarilor

Baze de date relationale:

- interogarile sunt planificate si executate in timp real

App Engine Standard Environment

- Fiecare interogare are un index de corespondenta mentinut in *datastore*

- Atunci cand aplicatia realizeaza o interogare, *datastore* gaseste indexul corespunzator acelei interogari, scaneaza pana la primul rand care se potriveste cu interogarea, si returneaza entitatea pentru fiecare rand consecutiv din index, procesul repetandu-se pana la primul rand care nu se potriveste cu interogarea

- Obs. App Engine trebuie sa stie dinainte ce interogari va face aplicatia; nu trebuie sa stie apriori valorile filtrelor, dar trebuie sa stie tipul entitatii dupa care se face interogarea, proprietatile dupa care se doreste filtrarea sau sortarea etc.

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Interogari si indexari

– App Engine furnizeaza un set de indecsi pentru interogari simple, bazandu-se pe ce proprietati si tipuri de entitati exista

– Pentru interogari complexe, o aplicatie trebuie sa includa in configuratia sa specificatii pentru indecsi

  • App Engine SDK ajuta la producerea acestor fisiere de configurare (e.g. supervizarea interogarilor pe care dezvoltatorul le-a realizat in timpul dezvoltarii aplicatiei – folosind serverul de dezvoltare pe computerul local. La incarcarea aplicatiei, *datastore* va crea indecsi pentru fiecare interogare a aplicatiei realizata in faza de dezvoltare)

    – Obs. Indecsii se pot configura si manual

– Atunci cind aplicatia creaza noi entitati, si actualizeaza pe cele existente, *datastore* actualizeaza fiecare index

=> interogarile sunt rapide

Tranzactii

- Cand o aplicatie are mai multi clienti care realizeaza operatii de citire/scriere simultana asupra acelorasi date => necesitatea mentinerii consistentei datelor

- Cand o aplicatie actualizeaza proprietatile unei entitati, App Engine asigura update-ul complet sau operatia de update va da eroare ⇔ update-ul unei entitati se realizeaza printr-o *tranzactie* (Proprietate: orice tranzactie este atomica)

- Cand o aplicatie doreste operatii cu mai multe entitati intr-o singura tranzactie, aplicatia va crea un *entity group*, asupra caruia App Engine va supraveghea realizarea tranzactiilor

- App Engine utilizeaza *optimistic concurrency control – >* aplicatia trebuie sa incerce realizarea unei tranzactii de mai multe ori inainte de a returna eroare

- Citirea unei entitati nu poate esua din cauza concurentei, aplicatia avand acces la cea mai stabila stare a entitatii

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Storage Services

* ***Statefull services***
  - **Blobstore**
  - **Datastore**
  - **Google Cloud SQL**
  - ***Memcache (memory cache) –*** este un serviciu de stocare cheie-valoare
    * Principalul avantaj fata de datastore: rapiditate in operatiile de stocare si regasire
    * Stocheaza valori in memorie si nu pe disk
    * Este distribuit ca si *datastore*, deci fiecare cerere vede aceeasi pereche cheie-valoare
    * Nu este persistent: daca un server esueaza, memoria este stearsa
    * Este utilizat pentru cash-ul rezultatelor celor mai frecvente interogari sau calculi
    * Se furnizeaza doua tipuri:
      - **Shared memcache**
      - **Dedicated memcache**

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Communication Services

- ***Stateless service APIs***
  - *URL Fetch*
    - Permite aplicatiilor App Engine sa acceseze alte resurse web (cereri HTTP(S) pentru obtinerea de pagini web, interactiune cu servicii Web)
    - Deoarece serverele *remote* pot raspunde greu, URL Fetch suporta *fetching URL* in background, in timp ce aplicatiile pot efectua si alte operatii
    - Obs. O astfel de operatie trebuie sa existe doar pe timpul de viata al aplicatiei
    - Aplicatia poate seta un deadline, pentru operatia de *fetch* => apelul se va incheia daca raspunsul nu este primit in timpul corespunzator
  - *Mail*
    - Aplicatiile pot trimite si primi mesaje sub forma de cereri HTTP initiate de App Engine si trimise catre aplicatie
    - Exemplu: notificarea utilizatorilor, confirmarea actiunilor utilizatorilor, validarea informatiilor de contact, etc.

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Communication Services

- **Statless service APIs**
  - *Sockets (beta)*
    - Comportamentul acestora variaza in functie de mediul de rulare
  - Twilio **Third-party**
    - Permite realizarea de apeluri telefonice
    - *Twillio Client* permite realizarea de apeluri VOIP de pe orice dispozitiv (suporta WebRTC)
  - Google Cloud Endpoints
    - Consta din instrumente si librarii care permit generarea de API-uri pe baza unei aplicatii, a.i. sa se usureze accesul la date din alte aplicatii

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Process Management Services

- *Task Queues*

Ideea: o aplicatie web trebuie sa ofere rezultatul cat mai rapid

- Problema: uneori sunt multe operatii de facut, care necesita mai mult timp, si care pot fi organizate in task-uri

- Solutia: *task queues*
  - Permite definirea de task-uri care se pot executa in background atunci cand resursele sistemului permit acest lucru

- Exista doua tipuri:
  - *Push Queues* - asigura faptul ca aceste taskuri sunt executate automat de sistem care scaleaza si realizeaza procesarile in functie de necesitati; de asemenea task-urile se sterg dupa procesare
  - *Pull Queues*
    - » ofera un control mai bun asupra momentului in care task-urile sunt executate, intr-un anumit interval de timp
    - » asigura integrarea aplicatiei cu *Task Queue REST API* ^{Alpha} - care permite managementul extern al task-urilor existente

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Process Management Services

– *Scheduled task (*sau *cron jobs)*

- Permite executarea de task-uri la un anumit moment

- Utile pentru mentenanta periodica (update a unor date din cache la fiecare 10 minute, ...) sau trimiterea de mesaje de notificare in fiecare zi

- Aplicatiile Free pot avea pana la 20 de astfel de procese (100 in celelalte cazuri)

Computation Services

– *Images*

- Permite realizarea de operatii asupra imaginilor (redimensionare, crop, flip, ...)

– *MapReduce*

- model de programare pentru procesarea de cantitati mari de date

- Foloseste Datastore si TaskQueues

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Servicii

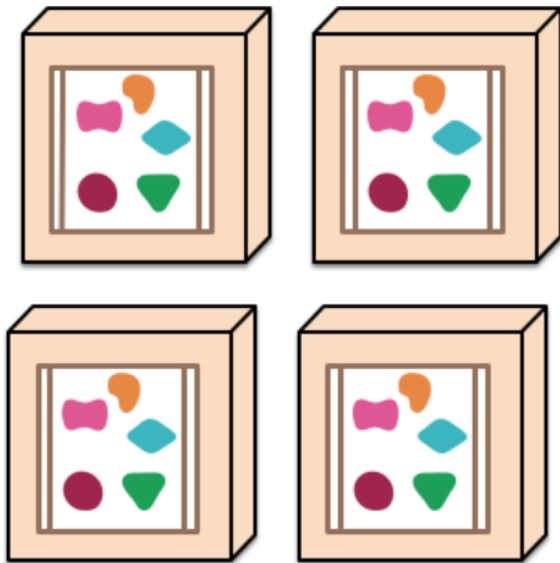|	
App Identity	A framework that provides access to the application's identity, and the ability to assert this identity using OAuth.
OAuth	Uses the OAuth protocol to provide a way for your app to authenticate a user who is requesting access without asking for credentials (username and password)
Remote	Access App Engine services from any application. For example, access a production datastore from an app running on your local machine.
Services	Factor applications into logical components that can share stateful services and communicate in a secure fashion.
Traffic Splitting	Routes incoming requests to different versions of your app, allowing you to do A/B testing and roll out new features incrementally.
Users	Allows applications to sign in users with Google Accounts, and address these users with unique identifiers.

....

Cum ne gandim aplicatia …. Microservices?

A monolithic application puts all its functionality into a single process...

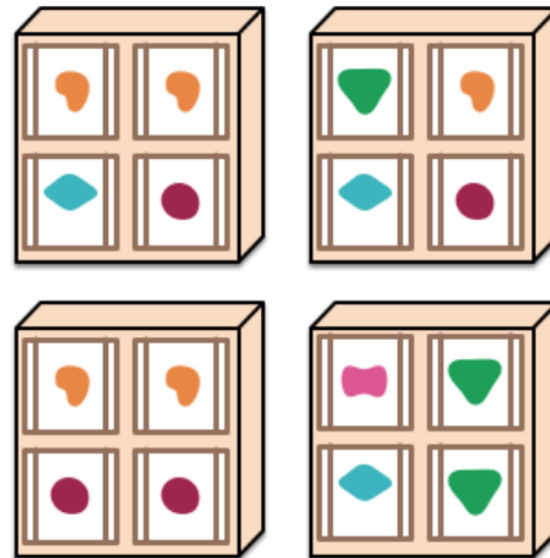A microservices architecture puts each element of functionality into a separate service...

... and scales by replicating the monolith on multiple servers
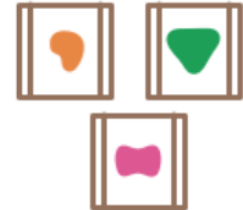
... and scales by distributing these services across servers, replicating as needed.
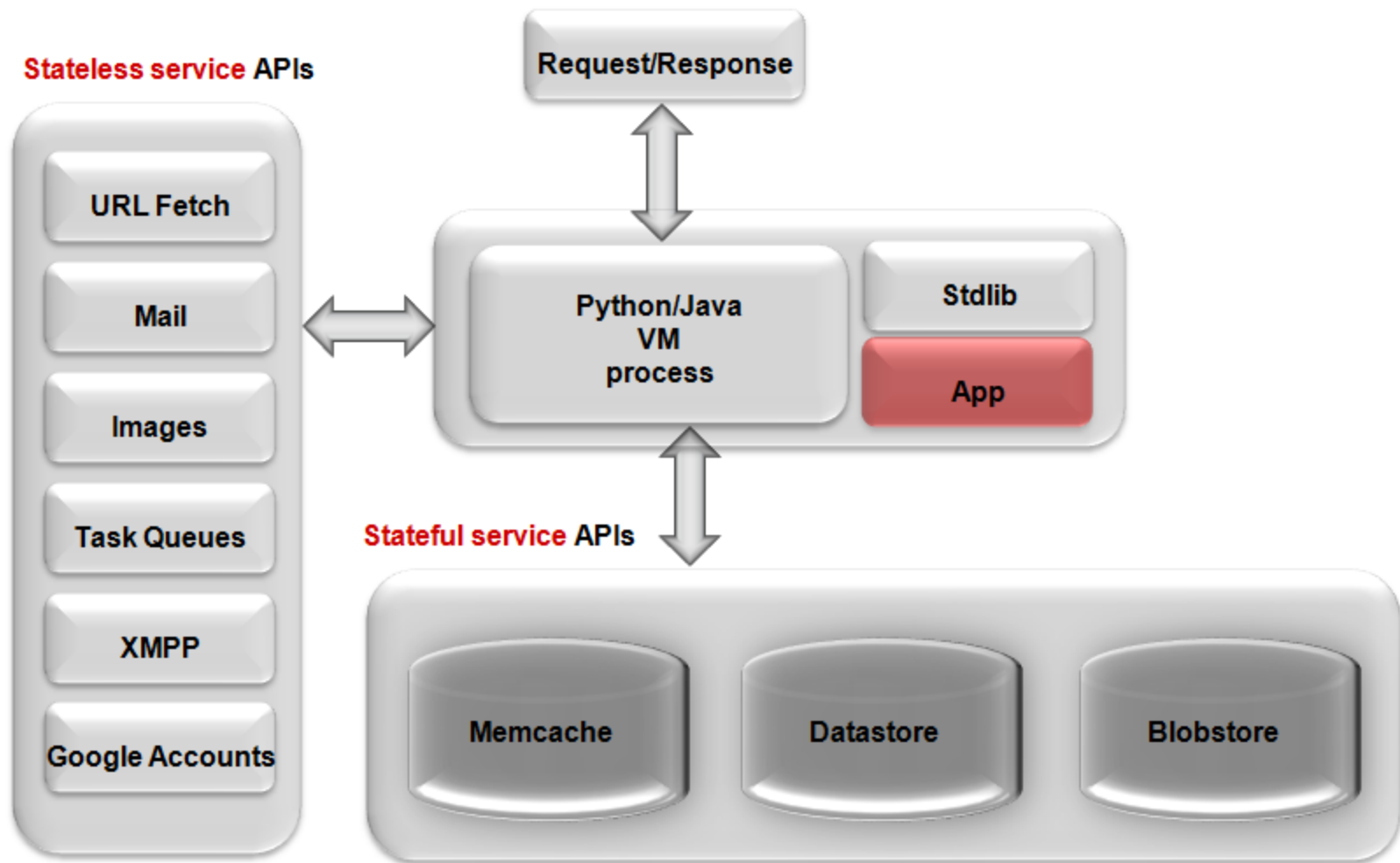
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Figura. Posibil mod de a utiliza serviciile GAE

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Scalability

Lower Total Cost of Ownership

Rich set of APIs

Fully featured SDK for local development

Ease of deployment

Web administration console and diagnostic utilities

Google

[http://www.slideshare.net/rajdeep/introduction-to-google-app-engine-presentation]

Google App Engine

Concluzii

- GAE – permite rularea de aplicatii web
- Configurare rapida
- Scalabilitate
- Securitate
- Scalabilitate
    - Totul este proiectat ca sa scaleze
    - *Low – usage apps:* multe aplicatii per host-ul fizic
    - *High- usage apps*: mai multe hosturi fizice per aplicatie
- …

Google App Engine

Costuri:

- http://code.google.com/appengine/docs/whatisgoogleappengine.html

  "*Not only is creating an App Engine application easy, it's free! You can create an account and publish an application that people can use right away at no charge, and with no obligation. An application on a free account can use up to 1 GB of storage and up to 5 million page views a month. When you are ready for more, you can enable billing, set a maximum daily budget, and allocate your budget for each resource according to your needs. You can register up to 10 applications per developer account*. …"

  http://code.google.com/appengine/docs/billing.html

  Exemplu: Costuri pentru operatii in datastore

Martie 2013

Operation	Cost
Write	$0.10 per 100k operations
Read	$0.07 per 100k operations
Small	$0.01 per 100k operations

Martie 2014

Operation	Cost
Write	$0.09 per 100k operations
Read	$0.06 per 100k operations
Small	$0.01 per 100k operations

Martie 2015

Operation	Cost
Read / Write	$0.06 per 100,000 operations
Small	Free

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Google App Engine

Resource	Free quota per day	Unit	Price beyond the free quota per unit
Stored data	1 GB	per GB per month	$0.18
Entity reads	50,000	per 100K entities	$0.06
Entity writes	20,000	per 100K entities	$0.18
Entity deletes	20,000	per 100K entities	$0.02
Small operations	Unlimited. Includes calls to allocate Cloud Datastore IDs, keys-only queries, and projection queries that do not use the distinct on clause. A keys-only query or a projection query that does not use the distinct on clause is counted as a single entity read for the query itself. The individual results are counted as small operations.		

[https://cloud
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appengine/p
ricing]

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Rezumat

- Google in Cloud
  - …pasi
  - Google App Engine
    - Costuri
    - Instrumente (GWT, GAS)
    - Caracteristici
    - Aspecte arhitecturale
    - Servicii
  - Concluzii

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Întrebări?