Programming Abstractions in Cloud

Shashikant Ilager

Assignment Project Exam Help

Research Fellow

https://powcoder.com

Information Systems Engineering

Vienna University of Technology, Austria

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Email: shashikantilager@tuwien.ac.at

Website: shashikantilager.com

Outline

- Cloud Computing
  - Computing as a utility
- Programming networked computers
  - TCP ports and sockets
  - RPC
- Cloud Application Platforms
  - Platform as a Service (PaaS)
- Aneka: A Cloud Middle-ware Platform
- Summary

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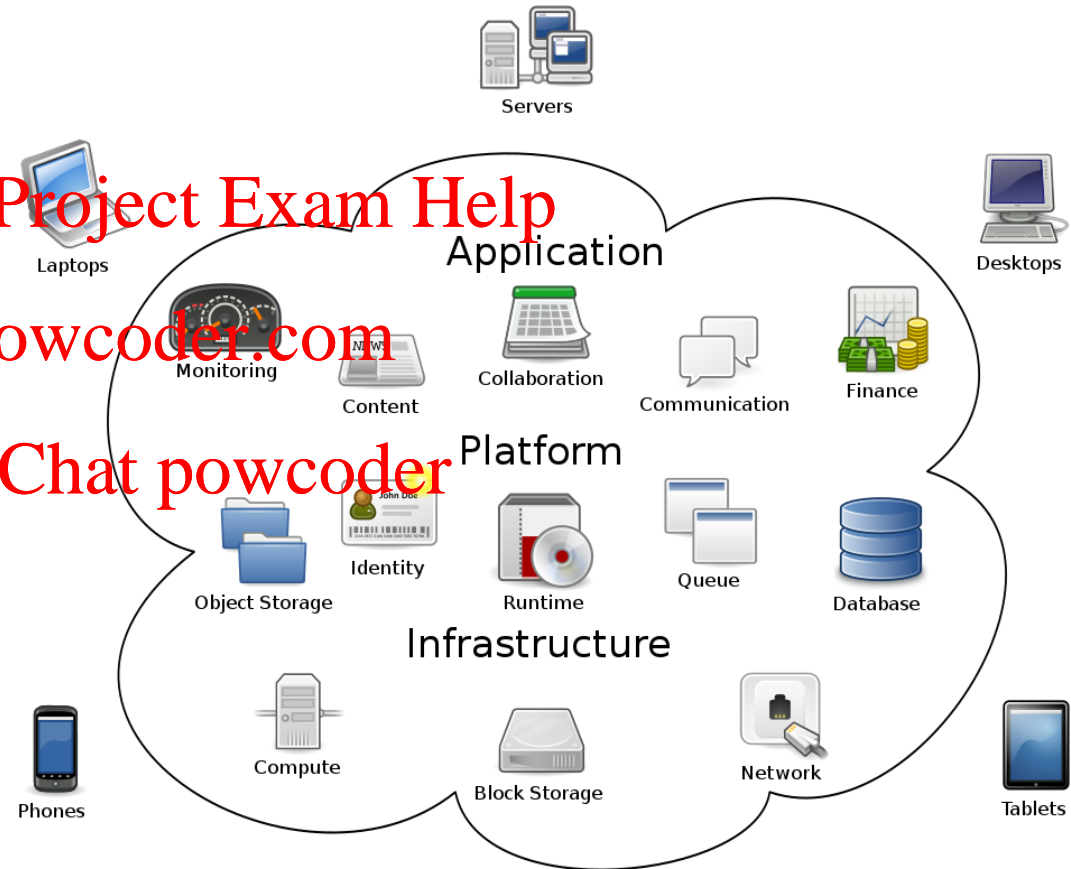https://powcoder.com

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Cloud Computing

- Outsource IT facilities to cloud providers
- Avoid expensive up-front investments
- Computing as a utility (like electricity, water, etc..)
- On-demand
- Pay for what you use
- Virtualized resources

Programming Networked Computers

- Sockets
  - Most familiar communication way for networked applications
  - Enables applications to interact with transport layer
  - Bound to a local port
  - IP address + port = Socket ID/ address
  - Socket can be used for sending and receiving data.
  - Acts as a programming interface to application code and transport layer
  - Each socket is associated with a protocol (UDP or TCP)

Programming Networked Computers

- Transmission Control Protocol (TCP)

  - Connection Oriented

  - Provides an abstraction for a two-way stream (called as packets).
  - Stream provide the basis for producer/consumer communication.
  - Data sent by the producer are queued until the consumer is ready to receive them.
  - Example use cases – http, ftp

  - TCP Socket Programming Demo

Programming Networked Computers

- Socket handling becomes complex when applications scale to large number of servers

  - Typical application in cloud spans from few hundred to thousands of servers
  - Individual port to each server
  - Read write buffers
  - Synchronization
  - Exception handling

  - All of the above functionalities within application makes developing application costly and erroneous
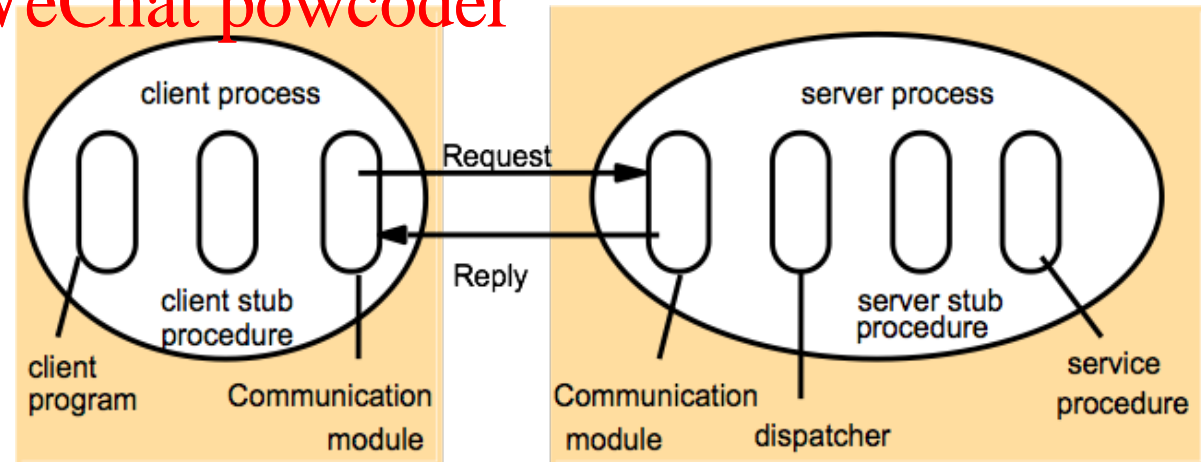
Programming Networked Computers

- Remote Procedure Call (RPC)
  - RPCs enable clients to execute procedures in server processes based on a defined service interface (Procedural languages, C, Fortran, Go)

  - Remote Method Invocation (RMI) for Object Oriented languages (JAVA)

  - Higher abstraction than sockets

- Key components of RPC:

  - Communication Module
  - Client Stub Procedure
  - Dispatcher
  - Server stub procedure

Programming Networked Computers

- RPC/ RMI is useful in simple applications where resources are usually static in nature (mostly worked during cluster/Grid computing era).

- Cloud applications are dynamic that requires

  - Elasticity – On demand resource/provision and de-provision
  - Monitoring – Heartbeat, Budget Constraints, etc.
  - Robustness – Availability, Failure management

- Middleware that seamlessly manages dynamic resources and handles runtime network communication is necessary.

Cloud Application Platforms

- Cloud Application Platforms (CAP) provide highest level of abstractions to build the applications

- Abstraction through SDKs, APIs and middle-ware platforms

- Less efforts on resource management and more focus on application

- Examples include
  - Google App Engine
    - Deploy web applications on the fly
  - Microsoft Azure PaaS platforms
    - Highly suitable platform for enterprise application developments
  - Aneka (Manjrasoft, CLOUDS Lab, UniMelb)
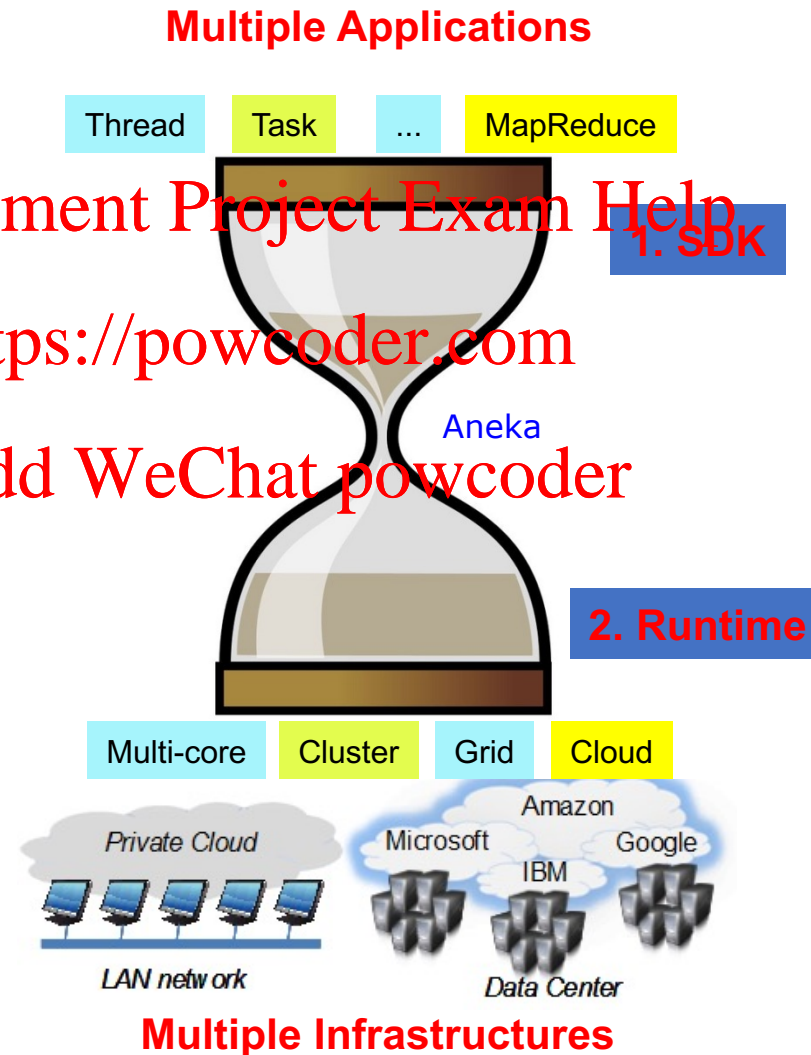   - Cloud application platform with multiple programming models
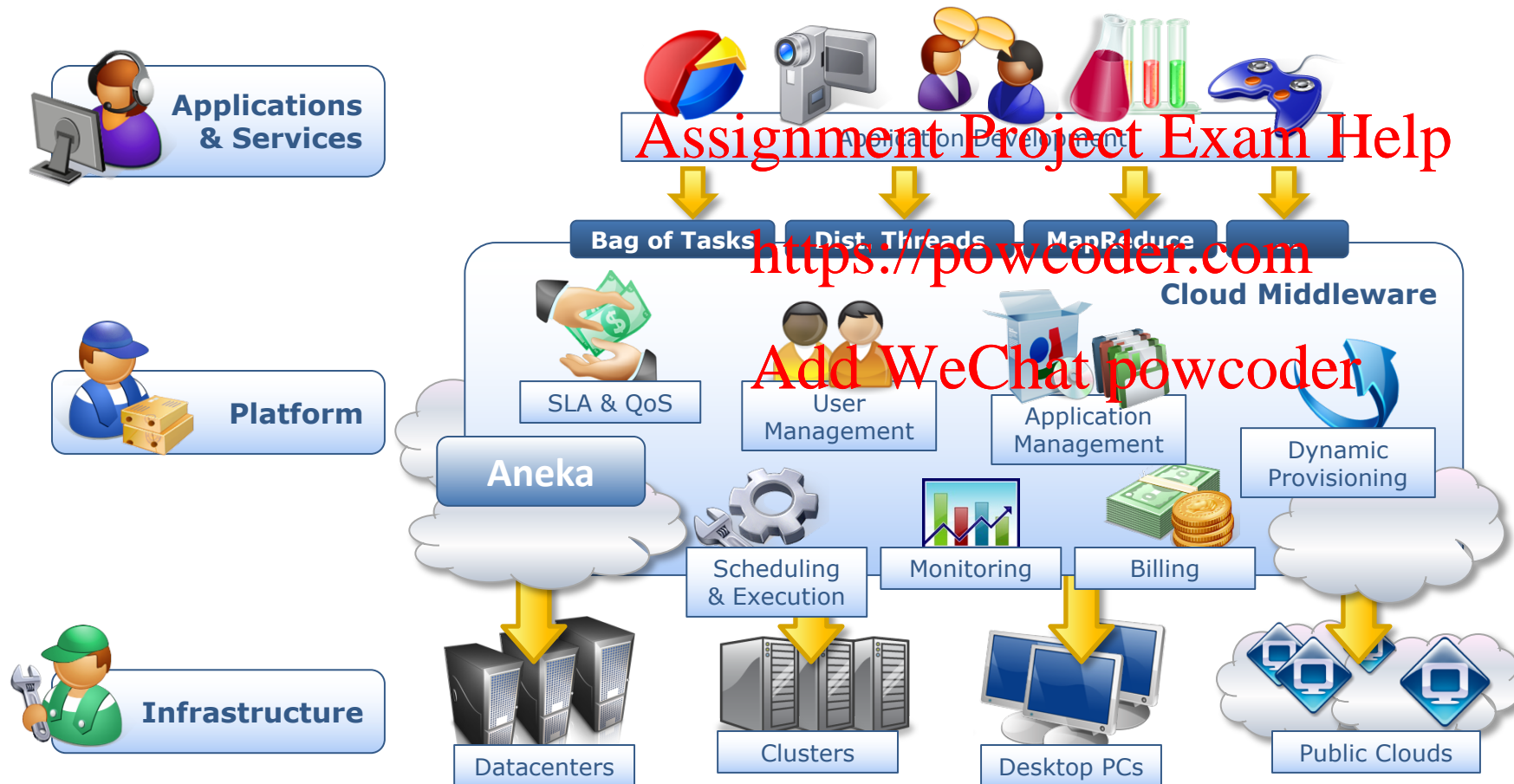
Aneka: Cloud Application Platform(CAP) for Resource-Intensive/Elastic Apps

- Platform supporting multiple Cloud programming models (Task, Thread, MapReduce)
- **SDK (Software Development Kit)** containing APIs for multiple programming models and tools
- **Runtime** Environment for managing application execution on Clouds
- Suitable for
    - Development of Enterprise Cloud Applications
    - Cloud enabling legacy applications
- Portability for Customer Apps:
    - Enterprise ⟷ Public Clouds
    - .NET/Win ⟷ Mono/Linux

Multiple Applications

Thread   Task   ...   MapReduce

1. SDK

Aneka

2. Runtime

Multi-core   Cluster   Grid   Cloud

Private Cloud

Amazon
Microsoft   Google
IBM

LAN network   Data Center

Multiple Infrastructures

Aneka as a Cloud Application Platform

Aneka as a Cloud Application Platform

- Aneka Demo

Summary

- Cloud Application Platforms like Aneka simplifies the process of building large scale distributed systems

- Although middle-ware platforms provide abstraction to programmer, the underlying complex operations are still need to be implemented inside these platforms.

- Acquiring skills to build such tools and platforms is crucial.

Thank You

Questions?

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For any queries, please contact me at: shashikant.ilager@tuwien.ac.at