

# Cloud computing

Jaro 2017

**Garance:** doc. RNDr. Eva Hladká, Ph.D., kontaktní osoba: Mgr. Kamil Malinka, Ph.D.

**Vyučující:** IBM, RedHat, UVT MU

**Za výuku zodpovídá:** Mgr. Kamil Malinka, Ph.D (UVT MU).

**Rozsah:** 2/0 2 kr. + ukončení kolokviem

**Termín a periodičita vyučování:** jaro 2016, každoročně

**Vyučovací jazyk:** angličtina

**Omezení zápisu do předmětu:** maximální počet studentů 35

**Navrhované zařazení:** Povinně volitelný předmět ve skupině Informační technologie

**Prerekvizity:** PA018 || PA151 || PA159 || PA191 || PV017 || PV157

Knowledge of English (intermediate level). Students shall also pass at least one of the following courses PA018, PA151, PA159, PA191, PV017, PV157 before registering this course.

## Sylabus předmětu

Cíle předmětu	Po ukončení předmětu by student měl být schopen: <ul style="list-style-type: none"><li>• porozumět základním konceptům cloud computing technologií a infrastruktury</li><li>• zvolit vhodné metody pro design a praktické nasazení cloudových systémů a aplikací</li></ul>
Cíle předmětu anglicky	Graduate of this course shall be able to: <ul style="list-style-type: none"><li>• understand basic concepts of cloud computing technologies and infrastructure</li><li>• select appropriate methods for design and practical deployment of cloud systems and applications</li></ul>
Osnova anglicky	<ol style="list-style-type: none"><li>1. Overview of cloud computing</li><li>2. Cloud computing concepts</li><li>3. Cloud Service Delivery Models</li><li>4. Cloud Deployment Scenarios</li><li>5. Cloud infrastructure – virtualization</li><li>6. Cloud infrastructure – data repositories</li><li>7. Cloud structure</li><li>8. Cloud Security - Security in Cloud Computing</li><li>9. Cloud providers</li><li>10. Scientific clouds - distributed computing and data storage infrastructure</li><li>11. Standards in cloud computing</li><li>12. Transition &amp; Migration to cloud computing environment</li></ol>
Výukové metody	Přednášky, vypracování praktického projektu, konzultace k projektům
Výukové metody anglicky	Lectures with slides, term project, consultations about projects

Metody hodnocení	Během přednášky bude zadán netriviální projekt nasazení cloudů . Jeho vypracování je povinné. Kurz je zakončen kolokviem, na kterém student obhájí řešení zadaného příkladu a zodpoví přidružené otázky
Metody hodnocení anglicky	During course, a non-trivial project of cloud implementation will be released. Its elaboration is mandatory. The course is finished with final colloquium. Credit will be awarded based on the project's implementation, submission of project documentation and the final oral presentation of project's implementation. The student will response associated questions

Další komentář	Předmět je vyučován každoročně. Výuka probíhá každý týden.
Literatura	<ul style="list-style-type: none"> <li>● Mell, P. &amp; Grance, t. (2011) The NIST Definition of Cloud Computing, (Special Publication 800-145). Gaithersburg MD: National Institute of Standards and Technology</li> <li>● The Economics of Cloud Computing - An Overview for Decision Makers, Bill Williams (ISBN-13: 978-1587143069 )</li> <li>● Cloud Computing - Automating the Virtualized Data Center, Venkata Josyula, Malcolm Orr, Greg Page (ISBN-13: 978-1587204340 )</li> <li>● Cloud Application Architecture - Building Applications and Infrastructure in the Cloud , George Reese (ISBN-13: 978-0596156367 )</li> <li>● Cloud Security and Privacy - an Enterprise Perspective on Risks and Compliance, Tim Mather, Subra Kumaraswamy, Shahed Latif (ISBN-13:978-0596802769 )</li> <li>● Review and summary of cloud security scenarios <a href="http://www.ibm.com/developerworks/cloud/library/cl-rev1security.html">http://www.ibm.com/developerworks/cloud/library/cl-rev1security.html</a></li> <li>● Review and summary of cloud service level agreements <a href="http://www.ibm.com/developerworks/cloud/library/cl-rev2sla.html">http://www.ibm.com/developerworks/cloud/library/cl-rev2sla.html</a></li> <li>● Change app behavior: From in house to the cloud <a href="http://www.ibm.com/developerworks/cloud/library/cl-appinhousetocloud/">http://www.ibm.com/developerworks/cloud/library/cl-appinhousetocloud/</a></li> </ul>

## ***Doplňující informace***

Cílem kurzu je poskytnout studentům podstatné informace o struktuře a konkrétním uplatnění cloudů. K získání aktuálních informací z praxe byly zvoleny dvě v Brně sídlící firmy IBM a Red Hat. Obě firmy na cloudových projektech spolupracují. Přednášející jsou špičkoví odborníci v oboru s perfektní znalostí angličtiny. Součástí kurzu je problematika vědeckých výpočetních cloudů, kterou zajišťuje UVT MU. Studenti tak získají tři různé pohledy na cloudová řešení, na druhé straně některá témata přednášek jsou společná a usnadňují návaznost výuky.

Za návaznost výuky a pokrytí všech témat až na úroveň slajdů osobně ručí Mgr. Kamil Malinka, Ph.D. Zajistí úroveň přednášek v souladu se zaměřením fakulty a potřebné synchronizace mezi přednášejícími. Bude přítomen na úvodní přednášce a prodiskutuje případné změny s přednášejícími, případně zajistí výuku v případě výpadku přednášejících.

Přednášející:

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## ***Přednášky – výstupy z učení a osnova přednášek***

### **1 Overview of cloud computing (IBM)**

- After completing this unit, you should be able to:
- Define cloud computing characteristics, benefits, concerns, driving factors, etc.
- Describe some of cloud computing concepts (elasticity,...)

#### Agenda

- What is a cloud?
- Definition of cloud computing
- Key characteristics of cloud computing
- Why use clouds
- How clouds are changing IT / industry
- Driving factors towards cloud computing
- Concerns related to cloud computing

### **2 Cloud Service Delivery Models (IBM)**

After completing this unit, you should be able to:

- Describe how cloud computing leverages the Internet
- Describe elasticity and scalability
- Describe the service delivery models of cloud computing
- Explain software as a service (SaaS)
- Explain platform as a service (PaaS)
- Explain infrastructure as a service (IaaS)
- Describe additional cloud services
- Illustrate a reference architecture for the PaaS cloud computing model
- Describe multitenancy
- Describe management in cloud

#### Agenda

- Elasticity and scalability
- Cloud service models - IaaS, PaaS, SaaS
- Common cloud management platform reference architecture
- Multitenancy
- Cloud Management

### **3 Virtualization technologies(RH)**

After completing this unit, you should be able to:

- Define virtualization
- List the characteristics of virtualized environments

- Define hypervisors
- Compare virtualized and non-virtualized systems
- Describe the types of hypervisors
- Recognize most common virtualization architectures
- Describe abstraction of hypervisor type

#### Agenda

- Virtualization
- Hypervisors
- Comparing non-virtualized vs. virtualized systems
- KVM – Modular kernel virtualization
- Libvirt – Common API for hypervisor type abstraction
- oVirt – Scale-in solution
- Future – Virtualization replacement technologies for performance oriented cloud deployments

#### **4 Cloud Deployment Scenarios (IBM)**

After completing this unit, you should be able to:

- List the four major cloud deployment types
- Describe the features of private, public, hybrid, and community clouds
- List some additional cloud deployment types
- Select the most appropriate deployment model based on a set of business and technical requirements

#### Agenda

- Cloud deployment models - public, private, hybrid, community clouds
- Selection criteria for cloud deployment types
- Case study - practical exercise

#### **5 Transition & Migration to cloud computing environment (IBM) -> PROJECT1 (cloud migration)**

After completing this unit, you should be able to:

- Explain what are steps to be taken when considering move to cloud computing environment

#### Agenda

- IBM - 6 key steps when moving to cloud environment
- IBM - Inhibitors and risks to cloud computing
- Cloud migration - typical mistakes to think about

#### **6 Cloud infrastructure – data repositories (RH)**

After completing this unit, you should be able to:

- Name and describe main storage principles
- Describe redundancy oriented and data redundancy mechanisms
- Describe principle of data deduplication and snapshots
- Name and identify High availability modes for cloud resources
- Briefly describe performance oriented data repositories

- Describe difference in ephemeral and persistent storage

#### Agenda

- Principles
- Redundancy
- Mirroring
- Deduplication
- Snapshotting
- High availability
- Storage access in cloud space

### **7 Cloud providers (RH)**

After completing this unit, you should be able to:

- To know examples and details of selected cloud offerings / providers so cloud education can be connected to real cloud computing implementations

#### Agenda

- Amazon
- Google
- Red Hat – oVirt
- Red Hat – OpenStack
- Red Hat - OpenShift

### **8 Scientific clouds - distributed computing and data storage infrastructure (MU) -> PROJECT2 (provisioning)**

After completing this unit, you should be able to:

- Know the basics, motivation and specifics of scientific cloud computing, major players and solutions used in contemporary clouds
- Know what to do to run your own workload in a scientific cloud

### **9 Cloud Security - Security in Cloud Computing (IBM)**

After completing this unit, you should be able to:

- Describe security considerations in cloud computing
- Identify security options available in cloud computing
- Identify the top security threats to cloud computing, be aware of security trends
- Be aware of security differences between private and public cloud
- Be aware of security and control frameworks
- Be aware of privacy concerns and approaches how to address them

#### Agenda

- Cloud security – inheritance
- Security responsibility – private vs public
- General areas of concerns
- Key security dangers to cloud computing
- Cloud Security framework / standards
- Cloud Security Implementation
- Data privacy
- Examples of security concerns that could affect trust of cloud clients

## **10 OpenStack - technical insight (RH)**

After completing this unit, you should be able to:

- understand architecture of OpenStack and its components
- name the most important part of OpenStack and know what they do
- use OpenStack and its components via default interface (CLI, Web UI)
- have basic information about how technical contributing to OpenStack works

Agenda

- OpenStack Overview
- OpenStack Clients and how to use them
- Contributing to OpenStack as a developer

## **11 Scientific clouds - cloud standards (MU)**

Agenda

- National e-infrastructure: Brief history and emergence of clouds
- European and national cloud computing infrastructures for science: Problems and solutions
- Open standards in the cloud (OCCI, CDMI, CIMI, ...)
- Workload management