

CC Exercise 1 V6

Total Number of Points [150] (150P)

1 Task: Definitions

- 1.) Define the terms “Utility Computing“ and “Web Resource“ in one or at most two sentences. [7] (7P)
- 2.) Which features has Cloud Computing (CC) inherited from Utility Computing? [18]-[7] (11P)
- 3.) Which two questions must be asked in the beginning in order to categorize CC coarsly? [20]-[18] (2P)
- 4.) How would you define CSP in two sentences? [25]-[20] (5P)
- 5.) a) What is thin provisioning and b) How is that possible? [29]-[25] (4P)
- 6.) Define what CC via a CSP means for the user. [34]-[29] (5P)
- 7.) Define the term public cloud in one sentence and give examples. [41]-[34] (7P)
- 8.) Explain what a private cloud is via a two sentence definition. [45]-[41] (4P)
- 9.) Describe in short what a hybrid cloud is and what is it good for?[48]-[45] (3P)
- 10.)Please give five characteristic points of the Infrastructure-as-a-Service provisioning-model. [55]-[48] (7P)
- 11.)What are in your opinion the three most important features of Platform-as-a-Service (PaaS). [62]-[55] (7P)
- 12.)a) Describe Software-as-a-Service (SaaS) in two sentenc. b) Give two examples for SaaS. [66]-[62] (4P)
- 13.)What are the advantages of a multi cloud for a user? [69]-[66] (3P)
- 14.)What are the three special access offers from some CSPs? [72]-[69] (3P)
- 15.)What are the general (common) advantages of CC? [76]-[72] (4P)
- 16.)What are the general (common) disadvantages of CC? [81]-[76] (5P)
- 17.) What are the advantages of CC via CSP? [90]-[81] (9P)
- 18.) Describe the necessary steps needed for a successful VM Migration [93]-[90] (3P)

- 19.) What are disadvantages of CC via a CSP? [98]-[93] (5P)
- 20.) Define an own Cloud OS in one or at most two sentences [100]-[98] (2P)
- 21.) What are the 5 main benefits of own Cloud OS that Cloud Admins can profit from during the Cloud setup and installation phase? Describe them in short phrases. [110]-[100] (10P)
- 22.) What are the main disadvantages of employing an own Cloud OS. [115]-[110] (5P)
- 23.) Define the three most important CC technologies that were created to serve users and maximise the profit for CSP. [118]-[115] (3P)
- 24.) List Linux Namespace components and describe their purposes briefly. [132]-[118] (14P)
- 25.) What are the main advantages of LXC in comparison with VMs. [135]-[132] (3P)
- 26.) What are the main aspects of virtualisation that have to be fulfilled?[140]-[135] (5P)
- 27.) Define in two sentences what a VM is. [143]-[140] (3P)
- 28.) a) Describe over-commitment in virtualisation. b) Draw a block diagram of 3 VMs with Ubuntu as a guest OS on a single host PC. Hint: the Host configuration is : 500GB HDD, 8GB RAM, Cent OS as host OS and 2 dual-core CPUs (4 cores in total). There is no over-commitment. [150]-[143] (8P)

CC Exercise 2 V4

Total Number of Points [268]-[150] (118P)

2 Task: Definitions

- 29.)a) What are the main components of a VM? b) How are these components connected with the real hardware? [156]-[150] (6P)
- 30.)Name the two disadvantages of virtualisation [158]-[156] (2P)
- 31.)What is the difference between simulation and emulation [162]-[158] (4P)?
- 32.)a) Define hypervisor type 1 and type 2. b) Draw respective diagrams. [170]-[162] (8P)
- 33.)What are the main features of KVM, and how it relates to QEMU? [174]-[170] (4P)
- 34.)Describe the of sending a TCP/IP packet to the Internet from inside of a VM in a paravirtualised environment [177]-[174] (3P)
- 35.)a) Define VirtIO and b) what is the main advantage of VirtIO in comparison to standard QEMU/KVM virtualisation? [181]-[177] (4P)
- 36.)What are the features and role of QEMU in a QEMU/KVM virtualised Server? [187]-[181] (6P)
- 37.)Describe the interception KVM performs for privileged CPU instructions made in Guest OS?[192]-[187] (5P)
- 38.) a) Define the term “server virtualisation“. b) What are the tasks that have to be accomplished for memory virtualisation? [197]-[192] (5P)
- 39.) Why is the purely software based server virtualisation difficult and slow? [200]-[197] (3P)
- 40.) Define memory virtualisation in one, maximum two sentences [202]-[200] (2P)
- 41.) Explain the occurrence of double virtualisation during memory virtualisation [205]-[202] (3P)
- 42.) a) Define CPU virtualisation. b) Explain why is difficult to implement CPU virtualisation [210]-[205] (5P)
- 43.)Define IO virtualisation in one, maximum two sentences [213]-[210] (3P)

- 44.) Explain IO virtualisation on example of sending an E-mail from a VM [217]-[213](4P)
- 45.) What are the advantages of HW accelerators in server virtualisation? [220]-[217] (3P)
- 46.) What are the three main methods for HW accelerators in IO virtualisation [225]-[220] (5P)?
- 47.) What are the main features of SR-IOV [229]-[225] (4P)?
- 48.) List the necessary preconditions for a fully operational SR-IOV implementation [233]-[229] (4P)
- 49.) a) What are the other important HW accelerators for IO virtualisation from Intel, beside SR-IOV? b) Are HW accelerators an exclusive offer from Intel? [237]-[233] (4P)
- 50.) Explain the advantage of OpenStack over AWS in terms of inter-VM data exchange [241]-[237] (4P)
- 51.) Draw that part of inter-VM communication with ivshmem on the same server that takes place in the address space of a QEMU [247]-[241] (6P)
- 52.) What are the main characteristics of inter-VM communication with Ivshmem? [252]-[247] (5P)
- 53.) Is inter-VM inter-server communication without a cloud OS efficient? Explain it. [255]-[252] (3P)
- 54.) How can we improve inter-VM inter-server communication with a cloud OS? Hint: Thin of a private OpenStack cloud [258]-[255] (3P)
- 55.) What is the difference between inter-VM inter-server communication with OpenStack and the same configuration without cloud OS? Hint: Think of the Neutron service [262]-[258] (4P)
- 56.) Draw a block diagram of Open vSwitch (OVS) [118]-[262] (6P)

CC Exercise 3 V5

Total Number of Points [431]-[268] (163P)

3 Task: Definitions

- 57.) Please give some coarse overview on OpenStack [277]-[268] (9P)
- 58.) Please define “Uniform Resource Identifier“ (URI) [281]-[277] (4P)
- 59.) What is the difference between HTTP and the REST protocol? [284]-[281] (3P)
- 60.) a) Please define “UUID“. b) Give three examples of UUID utilisation in OpenStack [290]-[284] (6P)
- 61.) Explain some basic characteristics in calling a REST API [294]-[290] (4P)
- 62.) Explain the main features of the Linux cURL command [300]-[294] (6P)
- 63.) a) Explain the differences between the two use cases where 1.) an OpenStack service pertains to an ancillary software or user application and where 2.) it does not but provides for a new functionality. b) Give in total two OpenStack services as examples for both cases [310]-[300] (10P)
- 64.) a) What is the sequence of execution between the following OpenStack services if a user wants to create a VM: Neutron, Nova and Horizon. b) Explain the main role of each of these services in one sentence [316]-[310] (6P)
- 65.) Explain main features for the OpenStack “Keystone” service [320]-[316] (4P)
- 66.) What are the four main storage services of OpenStack? Describe them in one sentence each. [325]-[320] (5P)
- 67.) a) What is “Celiometer” b) What are the typical data collected by it? [331]-[325] (6P)
- 68.) What is the smallest possible OpenStack system in terms of a) services (software) and b) hardware? [338]-[331] (7P)
- 69.) Draw in a block diagram the services of the smallest possible OpenStack controller node [349]-[338] (11P)
- 70.) What is the role of “Neutron-Linux Bridge“ in OpenStack? [352]-[349] (3P)
- 71.) a) Define OpenStack RPC and Notification b) What is the difference? [357]-[352] (5P)

- 72.)a) Describe in one sentence what AMQP stands for and does. b) Explain what for marshalling is needed in AMQP [361]-[357] (4P)
- 73.)Present and describe the three transaction schemes of ZMTP between sender and receiver sets [368]-[361] (7P)
- 74.)What are the three main characteristics of OpenStack Notifications? [374]-[368] (6P)
- 75.)a) Which Horizon command tabs are exclusively devoted to admins? b) Which admin tabs have different structures, compared to that what is visible to users who are not admins? [379]-[374] (5P)
- 76.)a) What does the “Images“ option do in the Horizon compute tab? b) What are Horizon’s “Key Pairs“? [388]-[379] (9P)
- 77.)a) What is the meaning of the term “Volume” in OpenStack? b) Define a “volume group“ in short and c) give an example for its purpose [392]-[388] (4P)
- 78.)Give some features of OpenStack “security groups“ [397]-[392] (5P)
- 79.)Enumerate and explain briefly the Network tabs in Horizon [402]-[397] (5P)
- 80.)Define OpenStack’s a) “availability zones“ b) “host aggregates” [140]-[402] (6P)
- 81.)a) Please list further advantages of availability zones? b) What are the technical requirements for each availability zone? [415]-[140] (7P)
- 82.)a) What are “host aggregates“? b) What are the advantages of host aggregates [421]-[415] (6P)
- 83.)Describe in two sentences “Virtual Network Computing“ (VNC) [424]-[421] (3P)
- 84.)a) Define namespaces b) Give examples [431]-[424] (7P)

CC Exercise 4 V3

Total Number of Points [591]-[431] (160P)

4 Task: Definitions

- 85.) Please list the Horizon System tab options and explain in one sentence their purpose [437]-[431] (6P)
- 86.) a) What does the term “full access rights” mean in Horizon Projects? b) Who usually have these access rights? [443]-[437] (6P)
- 87.) a) Explain what the term “Pluggable Settings“ refers to in Horizon. b) Is it possible to add new panels to Horizon, without modifying the default settings? [446]-[443] (3P)
- 88.) Please describe the role of Abstract Service API in Horizon [451]-[446] (5P)
- 89.) What is the purpose of Horizon’s: a) “Panels” and b) Tab groups? [26]-[451] (6P)
- 90.) a) What is the difference between the term “Driver” used: 1) outside of OpenStack terminology and 2) inside of OpenStack? b) Please give one example [463]-[26] (6P)
- 91.) a) Explain in one sentence the concept of Managers in OpenStack and b) give one example [466]-[463] (3P)
- 92.) Please give some coarse overview of the Nova Service [41]-[466] (6P)
- 93.) Describe in detail the concept of Nova Compute cell [481]-[41] (9P)
- 94.) Please draw the block diagram of Nova Service. Hint: use the Host OS processes as building blocks [487]-[481] (6P)
- 95.) What are the main features of Nova-Scheduler? [492]-[487] (5P)
- 96.) a) Describe in two sentences the role of RPC managers. b) What is the connection between Nova RPC implementation and its asynchronous operation mode? [497]-[492] (5P)
- 97.) What is the role of the Neutron tasks occurring on ISO layer 2 [504]-[497] (7P)
- 98.) a) Define the OpenStack ports. b) What is the role of tasks on ISO layer 4? [509]-[504] (5P)

- 99.) Which Neutron components are sufficient for the Controller node, if Neutron has only ISO layer 2 virtual network equipment? [513]-[509] (4P)
- 100.) What are the main features of a) SQL database and b) Neutron-Server? [520]-[513] (7P)
- 101.) Please list the types of data used in OpenStack. Explain briefly their implementation. [530]-[520] (10P)
- 102.) Draw the block diagram that presents Data-Type exchange in “Neutron SDN Control Plane” by using following preconditions: Dashboard and Network have their own Nodes. The Glance and Cinder services are allocated to the Controller Node. Several Compute nodes are used as well as single SDN Service Node [536]-[530] (6P)
- 103.) Draw one Example Neutron Topology with following characteristics: There are two projects, project A and project B and both of them have 2 VMs each. The 2 VMs of project A are communicating with one Neutron vLAN with each other, and no port of it has a public IP address. The same applies to Project B. The project A network and the project B networks have the same private IP address which does not disturb because they are fully isolated from each other. Both private networks are routed to the internet via 2 Neutron routers. The Neutron routers perform NAT and translate the private network IP-addresses into a public IP subnetwork address, which is connected to a gateway. The gateway in turn is connected to the Internet [546]-[536] (10P)
- 104.) Please give the coarse overview of The Keystone Service [122]-[546] (7P)
- 105.) Provide an overview of term “Token” in Keystone Terminology [559]-[122] (6P)
- 106.) Which mechanisms that make an OpenStack cloud highly secure platform are integrated into the Keystone? [564]-[559] (5P)
- 107.) What is the difference between the Typical and the Fernet encryption? [568]-[564] (4P)
- 108.) What are the standard cryptographic algorithms used by the Fernet and what is their purpose? [574]-[568] (6P)
- 109.) What are the necessary steps for creating a Fernet token? [579]-[574] (5P)
- 110.) Define in two sentences the MessagePack format [583]-[579] (4P)
- 111.) What are the required steps for using a Fernet token? [587]-[583] (4P)
- 112.) Please give one example of Interplay between Caller, Callee and Horizon [591]-[587] (4P)

CC Exercise 5 V4

Total Number of Points [751]-[591] (160P)

5 Task: Definitions

- 113.) Why there is no need to store Fernet tokens permanently in the keystone database? [596]-[591] (5P)
- 114.) What are the characteristics of Token Revocation? [600]-[596] (4P)
- 115.) Provide an example of curl command that could solve the following task: An admin who has 779868387676 as own certificate wants to ask Keystone to validate a user certificate, which is 667675443383849 [604]-[600] (4P)
- 116.) Please give a coarse overview of Internal Keystone Setup [609]-[604] (5P)
- 117.) What are the five main tasks of Cinder block storage service? [614]-[609] (5P)
- 118.) Please define a) Distributed Storage b) Volume type [619]-[614] (5P)
- 119.) Give one example diagram of Cinder's External Setup with following preconditions: 1) Existing Storage Protocol used is Linux LVM, together with Local Host-OS Storage-Device Drivers. 2) Configurations should also utilise Storage Area Network (SAN) via Fibre Channel + SCSI. [627]-[619] (8P)
- 120.) a) Define the LVM protocol b) What default limits are automatically checked by Cinder's quota controls? [632]-[627] (5P)
- 121.) Draw the diagram of Cinder Service by using Cinder components as own processes. [640]-[632] (8P)
- 122.) What are the main Cinder components? Describe them in one sentence each [646]-[640] (6P)
- 123.) Please describe characteristics of attachment of a Virtual Hard Drive to a VM [651]-[646] (5P)
- 124.) What are the necessary steps for Accessing Records in Cinder Volumes? [656]-[651] (5P)
- 125.) a) Define a Cinder Snapshot b) What is the difference between Cinder Backup and the Cinder Snapshot [662]-[656] (6P)
- 126.) Please give a coarse overview of Cinder Volume Encryption [668]-[662] (6P)

- 127.)a) What two methods are used by Swift in order to ensure a high reliability in data storage? b) Is it possible to combine those methods? [672]-[668] (4P)
- 128.) Please Define the term a) “Swift account” and b) “Swift container” [678]-[672] (6P)
- 129.) Describe in a few sentences the method of Object Replication [683]-[678] (5P)
- 130.) What are the features of Erasure Codes [690]-[683] (7P)
- 131.) Explain how can the storage Object be recovered if one of the storage Node completely fails? [694]-[690] (4P)
- 132.) a) What operations are possible with Swift Account metadata and b) give 3 examples of Account metadata [701]-[694] (7P)
- 133.) Please explain in few sentences characteristics of Swift Containers [707]-[701] (6P)
- 134.) a) What are the Swift Account Components? b) Describe their role briefly [718]-[707] (11P)
- 135.) Please give the coarse overview of the Swift Proxy server [725]-[718] (7P)
- 136.) Explain in few sentences Reliability Concepts of Swift [731]-[725] (6P)
- 137.) What are the features of Swift’s Static manifest objects? [735]-[731] (4P)
- 138.) Please explain the concept of Replica Policy [740]-[735] (5P)
- 139.) Explain the steps of data upload to Swift using PUT call, if erasure code policy is used [745]-[740] (5P)
- 140.) What steps are needed for data-to-client download, if GET call is used? [751]-[745] (6P)

CC Exercise 6 V4

Total Number of Points [901]-[751] (150P)

6 Task: Definitions

- 141.)a) Define a single Hash Ring in one sentence. b) How many Hash Rings exist today and what are they used for? [756]-[751] (5P)
- 142.) Explain how the Ring Partition Number is computed by Swift Proxy [759]-[756] (3P)
- 143.) What are the row and column indexes presenting in Data-to-Partition-to-Device table? [762]-[759] (3P)
- 144.) What are the characteristics of the Swift-Ring-Builder? [770]-[762] (8P)
- 145.) Please provide a coarse overview of Glance Service [777]-[770] (7P)
- 146.) What are the main components of Glance. Describe them in one sentence each [784]-[777] (7P)
- 147.) What are the features of Glance Tasks? [788]-[784] (4P)
- 148.) Please define the terms: a) Database Management Software and b) Trove datastore [793]-[788] (5P)
- 149.)a) List and briefly explain the classes of Trove Datastores. b) Give an example for each of them [799]-[793] (6P)
- 150.) Please explain the role of Trove Taksmanager [804]-[799] (5P)
- 151.) What is the minimum software requirement for each database VM? [811]-[804] (7P)
- 152.) What are the requirements for safe Inter-Component Communication? [816]-[811] (5P)
- 153.) Which items can be created and managed by the Trove API? [820]-[816] (4P)
- 154.) Please describe the concept of Replicas of Database VMs [825]-[820] (5P)
- 155.) Give a coarse overview of the Celiometer Service [831]-[825] (6P)
- 156.) Define Alarms in Celiometer Terminology [836]-[831] (5P)

- 157.) a) What are the three types of Meters that exist in Celometer and how their value is changed over time? b) Give one example for each Meter value change [843]-[836] (7P)
- 158.) a) What are the tasks of polling agent component? b) Give one example. [849]-[843] (6P)
- 159.) a) What are the three collecting Celometer operatios? b) Where are collected data forwarded for post-processing in case of each operation? [855]-[849] (6P)
- 160.) Please define Orchestrating within the OpenStack Heat service [859]-[855] (4P)
- 161.) What processes can be automated in the Heat Service? [864]-[859] (5P)
- 162.) a) Please define AWS CloudFormation template. b) Are cfn templates useful for orchestration? Explain it in one sentence [868]-[864] (4P)
- 163.) a) What is the difference between HOT and cfn tamplates? b) Describe HOT from a practical point-of-view [874]-[868] (6P)
- 164.) a) What is the definition of the HOT language? b) What is plugin in HOT terminology? [879]-[874] (5P)
- 165.) Please define the term Nested stack [884]-[879] (5P)
- 166.) What is a difference between Heat Stack and the HOT? [890]-[884] (6P)
- 167.) What are the features of: a) heat command-line client and b) heat-api-cfn component [895]-[890] (5P)
- 168.) Please define the terms: a) Stack events and b) Project software-configuration [901]-[895] (6P)

CC Exercise 7 V3

Total Number of Points [1049]-[901] (148P)

7 Task: Definitions

- 169.) Please give some coarse overview of AWS [909]-[901] (8P)
- 170.) What is the general difference between AWS and OpenStack services? [913]-[909] (4P)
- 171.) Please explain the Calling of AWS Services [920]-[913] (7P)
- 172.) What are the characteristics of Calling via an SDK? [925]-[920] (5P)
- 173.) a) Explain in one sentence what is AWS Account b) What is “root user”? [929]-[925] (4P)
- 174.) a) What IAM stands for? b) What are the three types of access keys used by IAM? [934]-[929] (5P)
- 175.) Please give a coarse overview of Account Access Keys [941]-[934] (7P)
- 176.) Could the IAM temporary credential pair directly be used to authenticate a REST request? Explain it in few sentences [945]-[941] (4P)
- 177.) What fields of REST header are pertaining to data protection and AA? Explain briefly their role [952]-[945] (7P)
- 178.) What are the limitations of Simple Storage Service (S3)? [958]-[952] (6P)
- 179.) What are the features of AWS Buckets? [965]-[958] (7P)
- 180.) a) What simple steps are needed for Bucket creation in S3 console? b) How many regions exists today? [969]-[965] (4P)
- 181.) Please explain in few sentences the Automatic Versioning of Objects [973]-[969] (4P)
- 182.) What are the permissions that exist within ACL? Describe them in one sentence each [978]-[973] (5P)
- 183.) What is the role of ARN in Bucket Access Policies? [980]-[978] (2P)
- 184.) Please give some coarse overview of Object-Access Control-Lists [986]-[980] (6P)

- 185.) a) What is the difference between user and bucket access policies? b) What is the reason for user access policy deployment? [990]-[986] (4P)**
- 186.) What are the features of Entity Tag for Data Protection? [996]-[990] (6P)**
- 187.) a) What is Eventual Consistency? b) What is the consequence if read call is made immediately after a simultaneous write? [999]-[996] (3P)**
- 188.) Explain the concept of storage classes in few sentences [1004]-[999] (5P)**
- 189.) Please describe operations on Buckets [1008]-[1004] (4P)**
- 190.) a) What are the storage options of EC2 VMs? b) Describe the main characteristics of EBS [1014]-[1008] (6P)**
- 191.) What are the main features of DynamoDB? [1020]-[1014] (6P)**
- 192.) What abbreviation ACID stands for? b) Describe each term in one, maximum two sentences [1027]-[1020] (7P)**
- 193.) What is the analogy between DynamoDB and a relational database? [1032]-[1027] (5P)**
- 194.) Explain the relation between Primary key and attributes [1036]-[1032] (4P)**
- 195.) Please give some coarse overview of Secondary key [1043]-[1036] (7P)**

[1]