



Cloud Computing & Big Data

PARALLEL & SCALABLE MACHINE LEARNING & DEEP LEARNING

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LECTURE 10

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Software-As-A-Service (SAAS)

November 05, 2020

Online Lecture



EUROPEAN OPEN
SCIENCE CLOUD

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UNIVERSITY OF ICELAND
SCHOOL OF ENGINEERING AND NATURAL SCIENCES
FACULTY OF INDUSTRIAL ENGINEERING,
MECHANICAL ENGINEERING AND COMPUTER SCIENCE



JÜLICH
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SUPERCOMPUTING
CENTRE

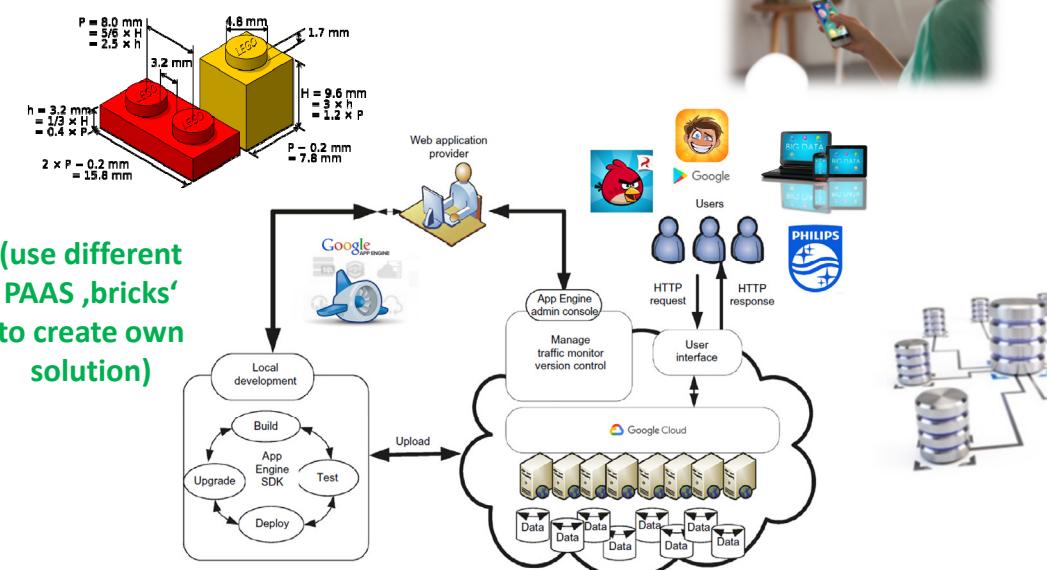
DEEP
Projects

HELMHOLTZAI

ARTIFICIAL INTELLIGENCE
COOPERATION UNIT

Review of Lecture 9 – Platform-As-A-Service (PAAS)

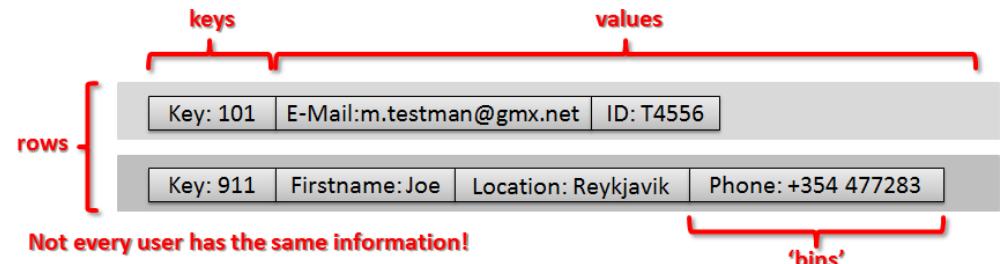
- PAAS ‘analogy’ & process



(use different PAAS ,bricks' to create own solution)

(role of container-based solutions for data science is growing)

▪ NoSQL PAAS Service ‘Lego Brick’ Example



(compared to schema-based traditional relational databases)



Machine Learning PAAS Services

Example: Natural Language Processing (NLP)



- | AI and Machine Learning → | | | |
|---|--|---|--|
|  Speech-to-Text
Speech recognition and transcription supporting 125 languages. |  Vision AI
Custom and pre-trained models to detect emotion, text, more. |  Text-to-Speech
Speech synthesis in 220+ voices and 40+ languages. |  Cloud Translation
Language detection, translation, and glossary support. |
|  Cloud Natural Language
Sentiment analysis and classification of unstructured text. |  AutoML
Custom machine learning model training and development. |  AI Platform
Platform for training, hosting, and managing ML models. |  Video AI
Video classification and recognition using machine learning. |
|  AI Infrastructure
Options for every business to train deep learning and machine learning models cost- |  Dialogflow
Conversation applications and systems development suite |  AutoML Tables
Service for training ML models with structured data. | <p>Not seeing what you're looking for?
See all AI and machine learning products</p> |



[1] Lego Bricks Modified from [2] Distributed & Cloud Computing Book [3] Philipps Case Study [4] Rovio Case Study [5] Google Cloud – Solutions [6] Google Cloud – Containers

Outline of the Course

1. Cloud Computing & Big Data Introduction
2. Machine Learning Models in Clouds
3. Apache Spark for Cloud Applications
4. Virtualization & Data Center Design
5. Map-Reduce Computing Paradigm
6. Deep Learning driven by Big Data
7. Deep Learning Applications in Clouds
8. Infrastructure-As-A-Service (IAAS)
9. Platform-As-A-Service (PAAS)
10. Software-As-A-Service (SAAS)

11. Big Data Analytics & Cloud Data Mining
12. Docker & Container Management
13. OpenStack Cloud Operating System
14. Online Social Networking & Graph Databases
15. Big Data Streaming Tools & Applications
16. Epilogue

+ additional practical lectures & Webinars for our hands-on assignments in context

- Practical Topics
- Theoretical / Conceptual Topics

Outline

■ Understanding SAAS Benefits

- Different Cloud Service Levels Reviewed
- SAAS Multitenant Architecture & Scalability fueled by Virtualization
- Customer Relationship Management (CRM) like Zoho & Freshworks
- Modern Software Delivery Model using Licensing & Pricing Models
- AWS Amazon Sagemaker SAAS Landscape for Machine Learning

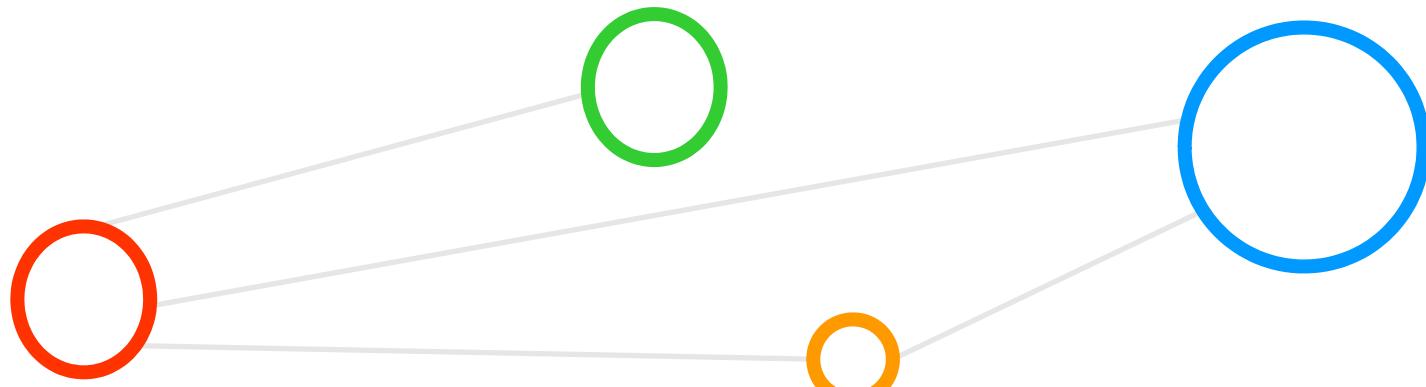
■ Advanced SAAS Topics & Applications

- Cross-selling Business Cases easily enabled by SAAS & ZOHO Example
- Cloud Security on Different Cloud Levels & Data ‘lock-in’ Concerns
- Advanced Collaboration with Social Features & Engineering Clouds
- Commercial MS, Google, Amazon, Conga, and UberCloud Examples
- Free EOSC Services for Researchers Examples & SAAS Disadvantages

- Promises from previous lecture(s):
- *Lecture 1 and Practical Lecture 7.1:* Lecture 10 provides more details about AWS Cloud services and its Software-as-a-Service (SAAS) models & other SAAS cloud services
- *Lecture 1:* Lecture 10 provides more details about the EOSC service landscape offering Software-as-a-Service (SAAS) models for EU researchers
- *Lecture 4:* Lecture 8 & 9 & 10 offer more insights into concrete cloud systems and their use of virtualization on different levels of cloud services
- *Lecture 4:* Lecture 8 & 9 & 10 will clarify & compare cloud deployment models with the different cloud computing layers IAAS, PAAS, and SAAS



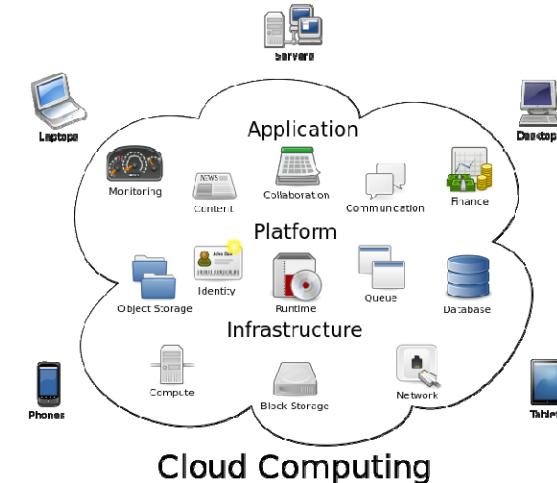
Understanding SAAS Benefits



Three Levels of Cloud Service Models: *AAS – Revisited

- Levels oriented towards different users
 - Full customization to direct usable applications
- Software as a Service (SaaS)
focus in this lecture
 - Provides specific 'ready-to-run applications'
 - Sometimes related to geographical location
- Platform as a Services (PaaS)
 - Virtual images ready to deploy your software
 - Includes a 'platform for creation of your services'
- Infrastructure as a Service (IaaS)
 - Provides 'bare metal infrastructure' & virtual IT resources (cf. Lecture 4)
 - Use and tune infrastructure as needed (compute, storage, networking, ...)

- Cloud computing infrastructures typically offer services on three different levels: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS) whereby also often some services build on one another (e.g., AWS EMR PaaS builds on top of AWS EC2 IaaS)
- Often Cloud computing service providers (i.e., AWS, MS Azure, Google Cloud) offer service on all these different levels today: IaaS, PaaS, and SaaS

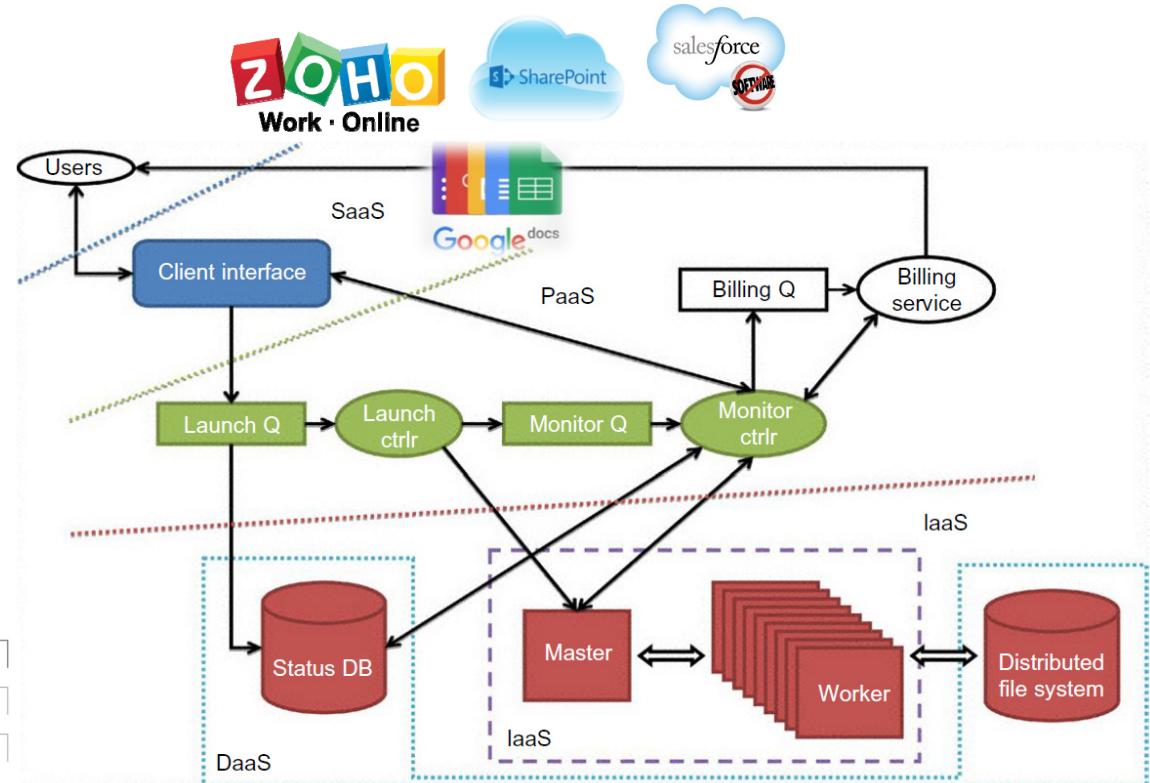
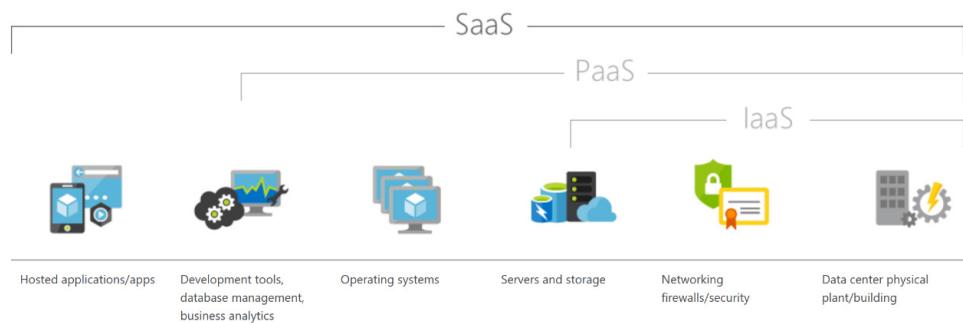


[13] Wikipedia
'Cloud computing'

Different Cloud Service Models – SAAS – Revisited

■ Software-As-A-Service (SAAS)

- E.g. services for business processes, consumer applications related to geographical locations, ...
 - E.g. ZOHO, SharePoint, Google Docs
 - E.g. Amazon AWS SageMaker
- The Conceptual ideas and key usage of the SAAS cloud service model include consume applications, avoid installations, special interfaces & ready-to-run applications
 - SAAS is based on easy accessible software remotely accessed via Web browsers and centrally hosted in data centers



[14] Microsoft Azure SAAS [2] Distributed & Cloud Computing Book

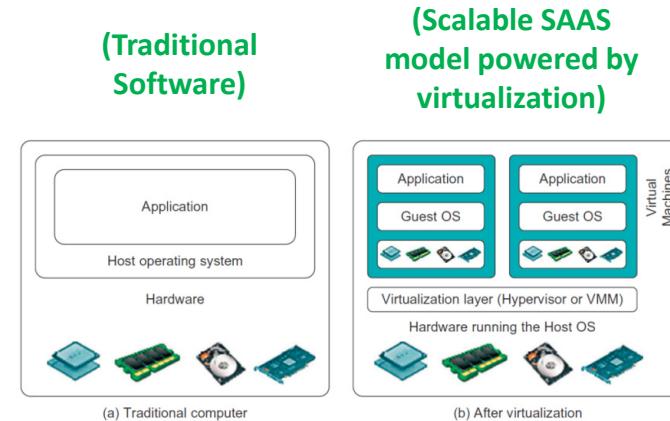
Understanding SAAS – Traditional Software vs. SAAS Multitenant Architecture

■ Traditional software

- Multiple physical copies of the software are installed across customers
- E.g. in different versions, different configurations, often customized
- If client-server architecture, server often was dedicated to application

■ SAAS Multitenant Architecture & Benefits

- One single version & configuration of an application provided in a cloud
- Sometimes second version of an application for beta or pre-releases for a selected groups of customers
- But better scalability via data centers and virtualization (cf. Lecture 4)



- The SAAS multitenant architecture refers to a single version of the software application with a single configuration (w.r.t. hardware, network, OS) that is used for all customers (aka 'tenants') and is underpinned by better scalability via virtualization than using traditional physical software copies

[2] Distributed & Cloud Computing Book

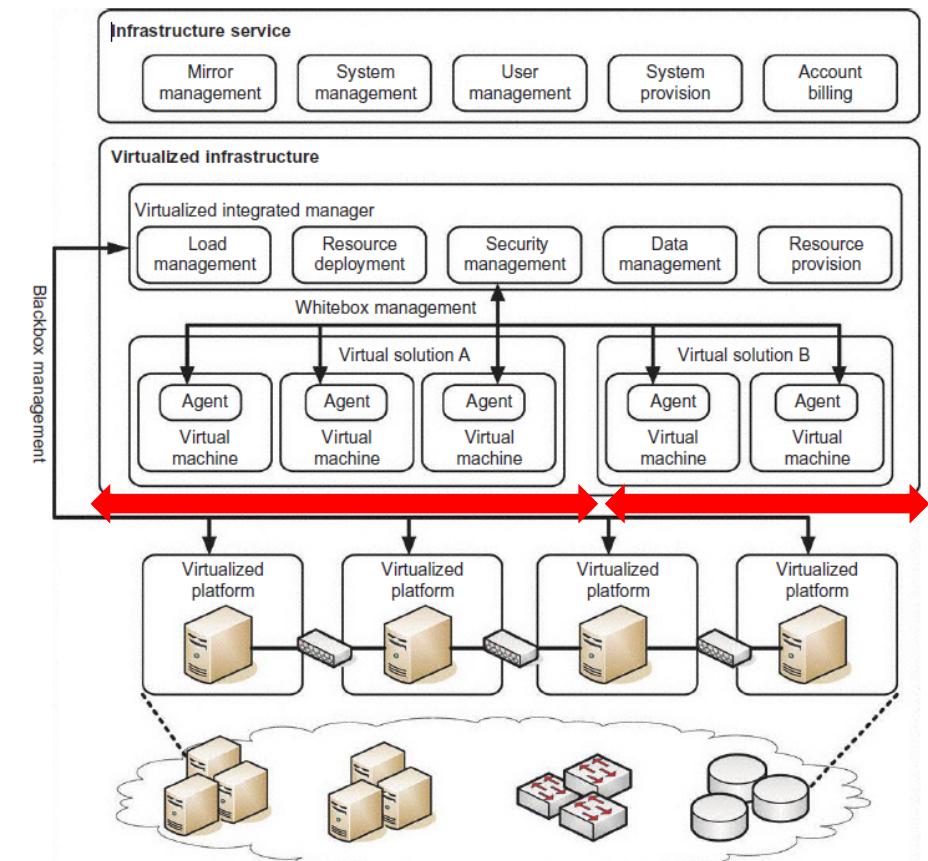
Horizontal Scalability enabled by Virtualization – Zoho CRM Example

■ Approach

- Data center with **virtual IT resources** (cf. Lecture 4) used by ZOHO
- E.g. for its CRM application & different versions of it
- **Virtual Solution A:**
ZOHO Production version used by customers
- **Virtual Solution B:**
ZOHO Beta version only for '**friendly**' or '**long trusted**' customers to test new functionality (e.g. new powerful machine learning)



▪ The **SAAS horizontal scaling** is a core feature and often implemented in practice whereby one version of the application is installed on multiple virtual IT resources in a cloud infrastructure



modified from [2] Distributed & Cloud Computing Book

Internet Cloud Systems – Examples from Every Day Life – CRM Example

- Selected **Cloud Systems (aka ‘Clouds’)** known today

- Google Cloud → massive computing/storage/applications
- Amazon Web Service → massive computing/storage/services
- Microsoft Azure → massive computing/storage/toolsets
- Facebook → online social networking & advertisement
- **SalesForce.com → customer relationship management**
- Rackspace → managed cloud provider & hosting
- IBM Bluemix → cloud platform
- Enomaly → elastic computing cloud
- European Open Science Cloud → computing & storage services for research
- Uber Cloud → specialized computing & storage services for engineers



Special Application Interfaces for Business Products & Selected SAAS Examples

■ Customer relationship management (CRM)

- Manages the interaction with current and potential future customers
- Analyzes 'big data' about customers history with a company
- Improves business relationships with customers (retention, sales growth) and often seamlessly connects to social media

salesforce.com
Success On Demand.

freshworks
freshworks CRM



■ Enterprise Resource Planing (ERP)

- Manage business processes of an organization online with colleagues
- Enables product planning and purchases, manufacturing or service delivery, marketing and sales, inventory management, shipping, payment, finance,...

Dolibarr
ERP/CRM

abas
ERP

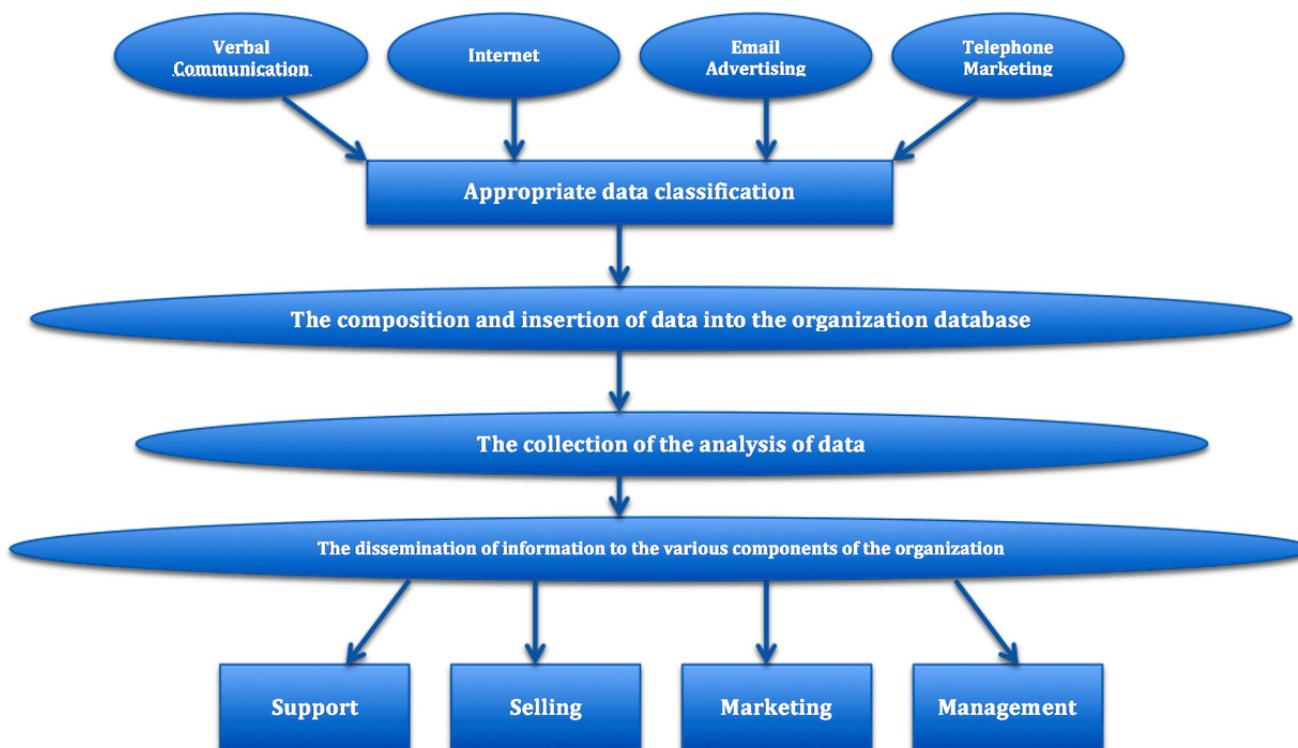
- SAAS is applied at the application end using highly special application interfaces by users
- SAAS solutions are highly specialized towards one specific application goal (private/business)
- SAAS Clouds are especially often used in the business areas of Customer Relationship Management (CRM) and Enterprise Resource Planing (ERP)

NETSUITE ONE WORLD

Your Entire Business Worldwide on One System



Customer Relationship Management (CRM) – Understanding Revenue Potential



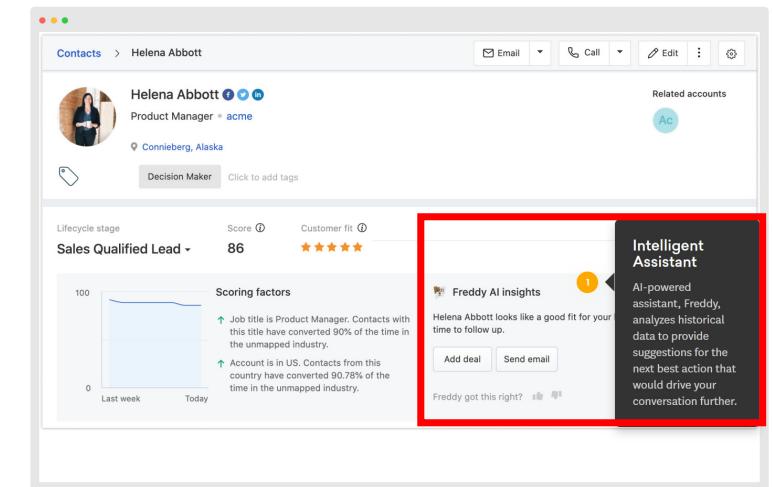
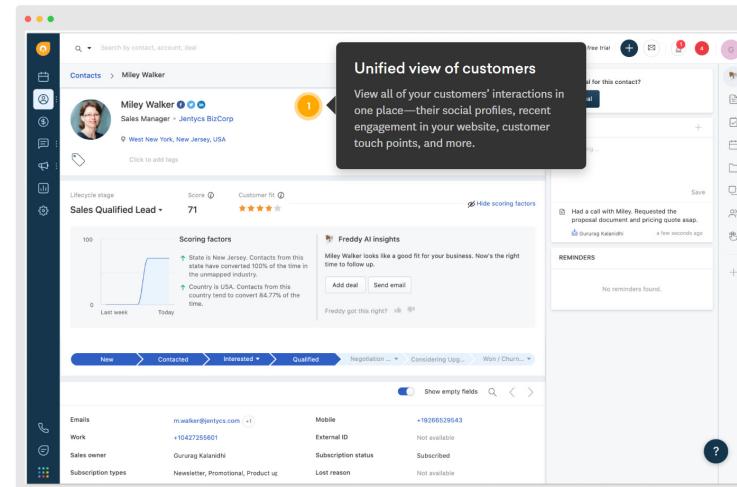
- Customer Relationship Management (CRM) is the largest SAAS market (revenue ~3.8 \$ billion in 2011)

[15] Wikipedia on 'CRM'

SAAS CRM Freshworks Example – Application Interface & Machine Learning

■ Customer in Focus & Challenges

- E.g., overview of communication channels & use Artificial Intelligence (AI)
- E.g., specifically supporting business processes for sales & marketing



- SAAS specialized application interfaces enable users to focus on one particular domain of business such as sales and marketing and do not mention any underlying IAAS IT resources nor PAAS IT components to abstract away technical complexity
- SAAS CRM enables overviews of communication channels & uses Artificial Intelligence (AI) to analyze the behavior of customers and to offer personalized recommendations

Top Rated CRM software



[16] Freshworks Web page

SAAS CRM ZOHO Example – Online Social Networking Links

The screenshot shows the ZOHO CRM interface for a contact record. The top navigation bar includes Home, Feeds, Leads, Accounts, Contacts (selected), Deals, Activities, Reports, Projects, and a three-dot menu. The main content area displays the contact's profile picture and name, with a blacked-out section for sensitive information. A 'Send Email' button and other action buttons are visible. On the left, a sidebar lists related items like Timeline, Notes, Attachments, Deals, Open Activities (2), Closed Activities, Invited Events, Products (1), Cases, Quotes, Sales Orders, Purchase Orders, Emails, Invoices, Campaigns, and Social. The 'Social' tab is selected under the 'INFO' section, showing a Facebook integration with a user profile picture and a 'Disassociate' link. Below this, there are 'Twitter' and 'Google+' buttons. A message at the bottom states 'No updates found.'

- CRM systems pull as much data about customers together as possible from different sources like E-Mails, purchase orders, transactions, communication, and even Online Social Networking sites



ZOHO CRM

[17] ZOHO CRM Web page

➤ Lecture 14 provides more insights into Online Social Networking & Related Cloud Business Activities including Graph Databases

SAAS Benefits via Modern Software Delivery Model – Two Perspectives

■ Software user perspective

- Centrally hosted solution in a remote data center, no local desktop setup
- Enables (temporarily) use of 'on-demand software' & flexible payments
- Accessed using a 'thin client' (phone, tablet, laptop) via Web browser/App
- No upfront investment in server or software maintenance teams

■ Software provider perspective

- Not distributed physically to SAAS consumers, instead it is deployed instantaneously in clouds
- Customer data is stored in the cloud (e.g. public PAAS or IAAS solutions)
- Enable discounts & automatic renewal
- Connected to powerful AI capabilities, because AI tools & servers easily usable



[17] ZOHO CRM Web page

The screenshot shows the Zoho CRM website. At the top, there's a navigation bar with links like 'Sign In', 'CRM Plus', 'Desk', 'Campaigns', 'Analytics', 'Teambox', 'All Products', and language settings. Below the header, a banner reads 'Sales forecasting done smarter with AI'. The main content area displays 'Subscription Details' and 'Recurring Details'. A red box highlights the 'Recurring Details' section, which includes fields for 'Recurring Amount' (\$240/year), 'Yearly discount of \$60 applied', 'Recurring On' (3 Jan 2018), and a 'Payment History' link.

- SAAS offers a modern delivery model for many software applications in business today including Customer Relationship Management (CRM), Enterprise Resource Planning (ERP), and many others
- SAAS has been incorporated into the strategy of nearly all leading enterprise software companies and often use powerful machine learning models today

Modern Software Delivery Model – Service Level Agreement

■ Service Level Agreements (SLAs)

- IAAS/PAAS/SAAS cloud models allow users to access IT resources or services over the Internet, **relying entirely on the provider infrastructure**
- Providers supply services by **signing SLAs with consumers & end users**
- More common in network services to ensure **Quality of service (QoS)**

Cloud Players	IaaS	PaaS	SaaS
IT administrators/cloud providers	Monitor SLAs	Monitor SLAs and enable service platforms	Monitor SLAs and deploy software
Software developers (vendors)	To deploy and store data	Enabling platforms via configurators and APIs	Develop and deploy software
End users or business users	To deploy and store data	To develop and test web software	Use business software

- IAAS/PAAS/SAAS cloud models are offered based on various Service Level Agreements (SLAs) between the cloud service providers and the end users or the user organization of services
- SLA for clouds address service availability, data integrity, privacy, security, data protection, etc.

Modified from [2] Distributed & Cloud Computing Book

Traditional vs. SaaS Licensing

■ Traditional licensing of software

- Conventionally software was **sold as a perpetual license**
- **Included up-front cost** for servers, ongoing support fee, number of users, ...

■ SaaS licensing

- SaaS providers generally price applications using a **subscription fee**
- E.g. most commonly a **monthly fee** or an **annual fee** (sometimes per user)
- Partly combined with (additional) service fees based on amount of usage
- **Different levels of functionality per license** (standard, professional, etc.)



freshworks CRM

[16] Freshworks Web page



ZOHO CRM

[17] ZOHO CRM Web page

Customer-for-Life Cloud		
Growth	Pro <small>POPULAR</small>	Enterprise
For small and fast growing businesses that need an all-in-one CRM	Best for larger teams that want to scale and build efficiency	Built for enterprises who need customization and control
\$29 per user per month, billed annually	\$69 per user per month, billed annually	\$125 per user per month, billed annually
SIGN UP	SIGN UP	SIGN UP
Includes	Everything in Growth, plus	Everything in Pro, plus
<ul style="list-style-type: none">✓ 1,000 Active Contacts✓ Contact, Account, & Deal management✓ Contact Lifecycle Stages✓ Live Chat & Facebook Messenger✓ Web Forms✓ Website Tracking✓ Built-In Phone & Email✓ 2-way Email Sync & Team Inbox✓ Predictive Contact Scoring✓ 1 Custom Domain	<ul style="list-style-type: none">✓ 3,000 Active Contacts✓ Lead Gen Bot✓ Answer Bot✓ WhatsApp & Apple Business Chat✓ Conference Calling✓ Smart Matches✓ Offline Events✓ 10 Custom Domains✓ Advanced Custom Fields✓ Behavioral Segmentation✓ 20 Active Marketing Journeys	<ul style="list-style-type: none">✓ 5,000 Active Contacts✓ Auto-profile Environment✓ Call Recording Opt-in & Opt-out✓ Queue Callback (Virtual Hold)✓ Holiday Routing✓ 25 Custom Domains✓ Custom Sales Activities✓ 10 Custom Modules✓ Field-level Permissions✓ Deal Teams✓ Audit Logs

FREE	STANDARD	PROFESSIONAL	ENTERPRISE	ULTIMATE
\$0 /user/year	\$12 /user/month billed annually \$15 month-to-month	\$20 /user/month billed annually \$25 month-to-month	\$35 /user/month billed annually \$40 month-to-month	REQUEST PRICING Minimum 100 users
DOWNGRADE	DOWNGRADE	CURRENT EDITION	UPGRADE	CONTACT
Leads Accounts Contacts Feeds Documents Mobile Apps	Sales forecasting Reports and dashboards Document Library Roles and profiles Mass email	Email Integration Social CRM Google AdWords integration Custom buttons Workflow approval processes Inventory Management	Territory management Custom applications Custom buttons Workflow approval processes Page layouts	Sandbox Dedicated Database cluster Priority support Advanced customization Advanced CRM analytics
...

SAAS Licensing – Freemium Model Example

- CRM SAAS provider

- Low cost for user provisioning (e.g. setting up a new customer)
- Operates service as a multitenant architecture
- E.g. enables to use of the freemium model
- E.g. enables to offer services for free whereby revenues are derived from advertising



ZOHO CRM

[17] ZOHO CRM Web page

A screenshot of the Zoho CRM web interface. The top navigation bar includes Home, Projects, Feeds, Leads, and other icons. On the left, a sidebar lists Setup, General, Users and Control, Customization, Automation, Extensions & APIs, and Zoho. The main content area shows the 'Advanced CRM Analytics' page, which describes its features and offers a 15-day free trial. A green 'Configure' button is at the bottom right of this section. The bottom of the screen shows a footer with Chats, Contacts, and Smart Chat instructions, along with a clock icon.

- SAAS enables the use of the freemium model that is a free service (e.g. in order to ‘hook’ customers) with limited functionality and scope whereby fees are often charged for enhanced functionality or for a larger scope of usage

AWS Amazon Sagemaker SAAS – Revisited (cf. Lecture 1 & 7.1)

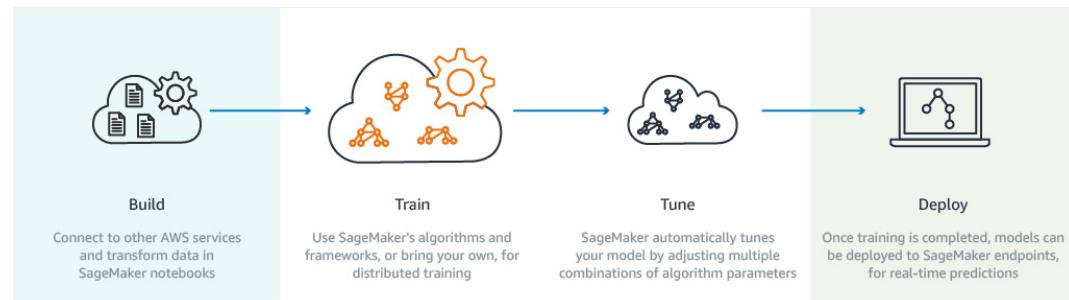
■ AWS Cloud – [Amazon Sagemaker](#)

- Fully managed service that enables quick & easy machine & deep learning applications
- Avoids time-consuming manual installation of many required software frameworks
- Builds on-top of various IAAS & PAAS services

The screenshot shows the AWS Amazon SageMaker console. The left sidebar is highlighted with a red box and contains the following navigation items:

- Dashboard
- Notebook
 - Notebook instances
 - Lifecycle configurations
- Training
 - Training jobs
 - Hyperparameter tuning jobs
- Inference
 - Models
 - Endpoint configurations
 - Endpoints
 - Batch transform jobs

The main content area displays the Amazon SageMaker logo and tagline "Build, train, and deploy machine learning models at scale". It includes a "Get started" section with a "Create notebook instance" button (also highlighted with a red box) and a "How it works" section showing a flowchart from Build to Train to Tune to Deploy.



(SAAS solutions often abstracts away completely underlying resources)

- AWS Amazon Sagemaker is a SAAS oriented service that provides fully managed instances running Jupyter notebooks that include examples training & tuning various machine and deep learning models
- Offers Amazon SageMaker Studio as a fully integrated development environment (IDE) for machine learning in the AWS cloud
- SAAS services are usually not free and often require a subscription



[7] Jupyter Web page



[8] AWS – Amazon Sagemaker

Sagemaker SAAS Services Landscape to Support Machine Learning

The diagram illustrates the Sagemaker SAAS Services Landscape to Support Machine Learning, showing various services and their integration:

- Label**: A section containing "Amazon SageMaker Ground Truth" (Build and manage training data sets).
- Build**: A section containing "Amazon SageMaker Studio" (Integrated development environment (IDE) for machine learning), which is highlighted with a red box.
- Train & Tune**: A section containing:
 - "Amazon SageMaker Autopilot" (Automatically build and train models)
 - "Amazon SageMaker Notebooks" (One-click notebooks with elastic compute), which is highlighted with a red box.
 - "Amazon SageMaker Experiments" (Capture, organize, and search every step), which is highlighted with a red box.
 - "AWS Marketplace" (Pre-built algorithms and models)
 - "Amazon SageMaker Debugger" (Debug and profile training runs)
 - "Automatic Model Tuning" (One-click hyperparameter optimization)
- Deploy & Manage**: A section containing:
 - "Amazon SageMaker Model Monitor" (Automatically detect concept drift)
 - "Amazon SageMaker Neo" (Train once, deploy anywhere)
 - "Amazon Augmented AI" (Add human review of model predictions)

Dashed red arrows point from the "Amazon SageMaker Studio" box in the "Build" section to the "Amazon SageMaker Studio" window and the "Trial Component Chart" window. Dashed red arrows also point from the "Amazon SageMaker Notebooks" and "Amazon SageMaker Experiments" boxes in the "Train & Tune" section to the "Trial Component List" and "Trial Component Chart" windows respectively.

Amazon SageMaker Studio (Top Right):

- Shows a Jupyter notebook titled "xgboost_customer_churn.ipynb".
- Code snippet:

```
model_data = pd.get_dummies(churn)
model_data = pd.concat([model_data['Churn'], Train], axis=1)
model_data.drop(['Churn'], axis=1, inplace=True)
```
- Output: "Have the predictor variable in the first column
Not have a header row"
- Text: "But first, let's convert our categorical features into numeric features."
- Code snippet:

```
train_data, validation_data, test_data = np.split(model_data.sample(frac=1), [int(.7*len(model_data)), int(.2*len(model_data)), int(.1*len(model_data))], axis=0)
```
- Text: "And now let's split the data into training, validation, and test sets. This will help prevent us from overfitting the model, and allow us to test the model's accuracy on data it hasn't already seen."
- Code snippet:

```
train_data.to_csv('train.csv', header=False, index=False)
validation_data.to_csv('validation.csv', header=False, index=False)
test_data.to_csv('test.csv', header=False, index=False)
```
- Text: "Now we'll upload these files to S3."
- Code snippet:

```
boto3.Session().resource('s3').bucket(bucket).Object(os.path.join(prefix, 'train')).put_object(Body=open('train.csv', 'rb'))
```
- Text: "We're all set! Let's move on to training our model."

Amazon SageMaker Studio (Bottom Right):

- Shows the "Trial Component List" and "Trial Component Chart" panels.
- "Trial Component List" shows 10 rows selected, mostly completed experiments.
- "Trial Component Chart" shows a line chart titled "trainloss_last with 1-minute aggregation" with multiple colored lines representing different trials.

Jupyter Web page (Bottom Right):

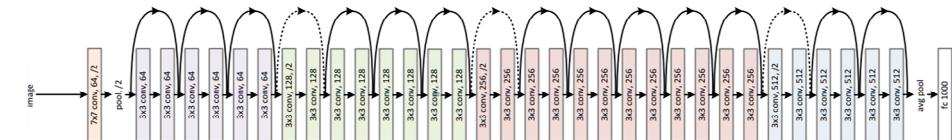
- Shows the Jupyter logo.
- Text: "[7] Jupyter Web page

AWS – Amazon Sagemaker (Bottom Right):

- Shows the AWS logo.
- Text: "[8] AWS – Amazon Sagemaker

AWS Amazon Sagemaker SAAS – Pricing & Costs for Deep Learning & Accelerators

Studio Notebooks				On-Demand Notebook Instances	Processing	Training	Real-Time Inference	Batch Transform
SageMaker Studio Notebooks								
Studio notebooks are one-click Jupyter notebooks that can be spun up quickly. The underlying compute resources are fully elastic. These notebooks can be easily shared with others enabling seamless collaboration.								
Region: US East (Ohio) ↗								
Standard Instances	vCPU	Memory	Price per Hour					
ml.t3.medium	2	4 GiB	\$0.0582					
ml.t3.large	2	8 GiB	\$0.1165					
ml.t3.xlarge	4	16 GiB	\$0.233					
ml.t3.2xlarge	8	32 GiB	\$0.4659					
ml.m5.large	2	8 GiB	\$0.1344					
ml.m5.xlarge	4	16 GiB	\$0.269					
ml.m5.2xlarge	8	32 GiB	\$0.538					
ml.m5.4xlarge	16	64 GiB	\$1.075					
ml.m5.8xlarge	32	128 GiB	\$2.1504					
ml.m5.12xlarge	48	192 GiB	\$3.226					
ml.m5.16xlarge	64	256 GiB	\$4.3008					
ml.m5.24xlarge	96	384 GiB	\$6.451					
Compute Optimized	vCPU	Memory	Price per Hour					
ml.c5.large	2	4 GiB	\$0.119					
ml.c5.xlarge	4	8 GiB	\$0.238					
ml.c5.2xlarge	8	16 GiB	\$0.476					
ml.c5.4xlarge	16	32 GiB	\$0.952					
ml.c5.9xlarge	36	72 GiB	\$2.142					
ml.c5.12xlarge	48	96 GiB	\$2.856					
ml.c5.18xlarge	72	144 GiB	\$4.284					
ml.c5.24xlarge	96	192 GiB	\$5.712					



Amazon SageMaker

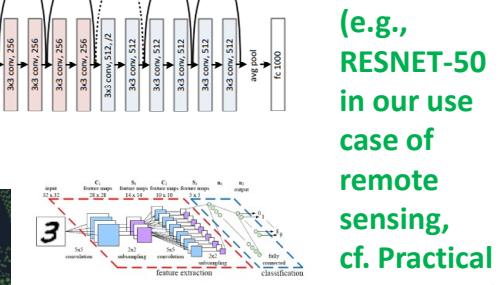
Machine learning for every developer and data scientist

[Get Started with SageMaker](#)

FEATURED LAUNCH

SageMaker Global GPU Price Reductions

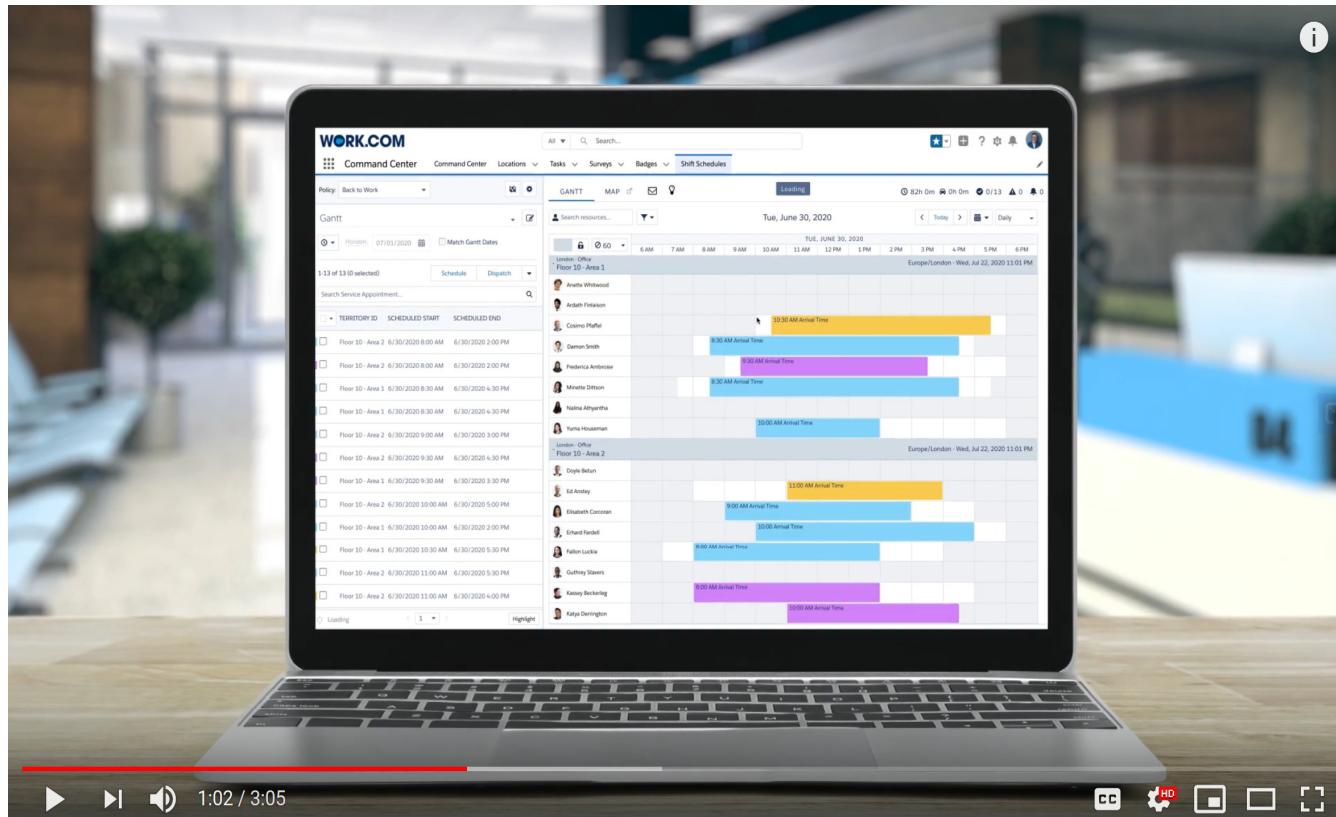
Learn how you can accelerate your deep learning applications at lower GPU costs using Amazon SageMaker.



(e.g., simple MNIST, [35] A. Rosebrock, cf. Practical Lecture 7.1) [36] R. Sedona & M. Riedel et al., 2019

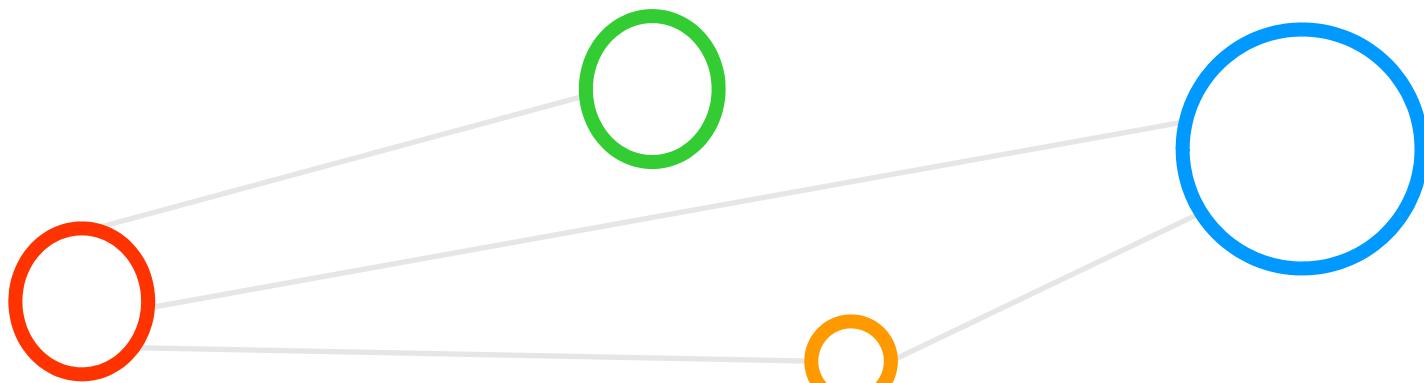
Accelerated Computing			
	vCPU	Memory	Price per Hour
ml.p3.2xlarge	8	61 GiB	\$3.825
ml.p3.8xlarge	32	244 GiB	\$14.688
ml.p3.16xlarge	64	488 GiB	\$28.152
ml.g4dn.xlarge	4	16 GiB	\$0.7364
ml.g4dn.2xlarge	8	32 GiB	\$1.0528
ml.g4dn.4xlarge	16	64 GiB	\$1.6856
ml.g4dn.8xlarge	32	128 GiB	\$3.0464
ml.g4dn.12xlarge	48	192 GiB	\$5.4768
ml.g4dn.16xlarge	64	256 GiB	\$6.0928

[Video] Salesforce Work.com SAAS Solution



[18] YouTube video, *Introduction to Map-Reduce Framework*

Advanced SAAS Topics & Applications



Easier Cross-selling & Business Case in Clouds & Zoho Example

Zoho Store

SALES & MARKETING

- CRM ✓
- Motivator
- Campaigns
- Survey
- Sites
- SalesIQ ✓
- Social ✓
- ContactManager ✓
- Forms

HELP DESK SOFTWARE

- Support
- Assist

BUSINESS PROCESS

- Creator
- Reports ✓
- Site24x7

FINANCE

- Books
- Invoice
- Subscriptions
- Expense
- Inventory

EMAIL & COLLABORATION

- Mail ✓
- Chat ✓
- Connect
- Docs
- Projects
- BugTracker
- Meeting ✓
- ShowTime
- Vault

HUMAN RESOURCES

- People
- Recruit

My Apps

- The SAAS providers often perform cross-selling that refers to the practice of selling one or more additional SAAS-based services to an existing customer of a particular SAAS application
- The benefit for customers of using several SAAS applications from the same SAAS provider is the same login (e.g. federated identity), settings (e.g. user parameters), and automated data exchange



ZOHO CRM

[17] ZOHO CRM Web page

Remote Sales Office Featured

Stay in touch with your prospects and customers while working remotely.

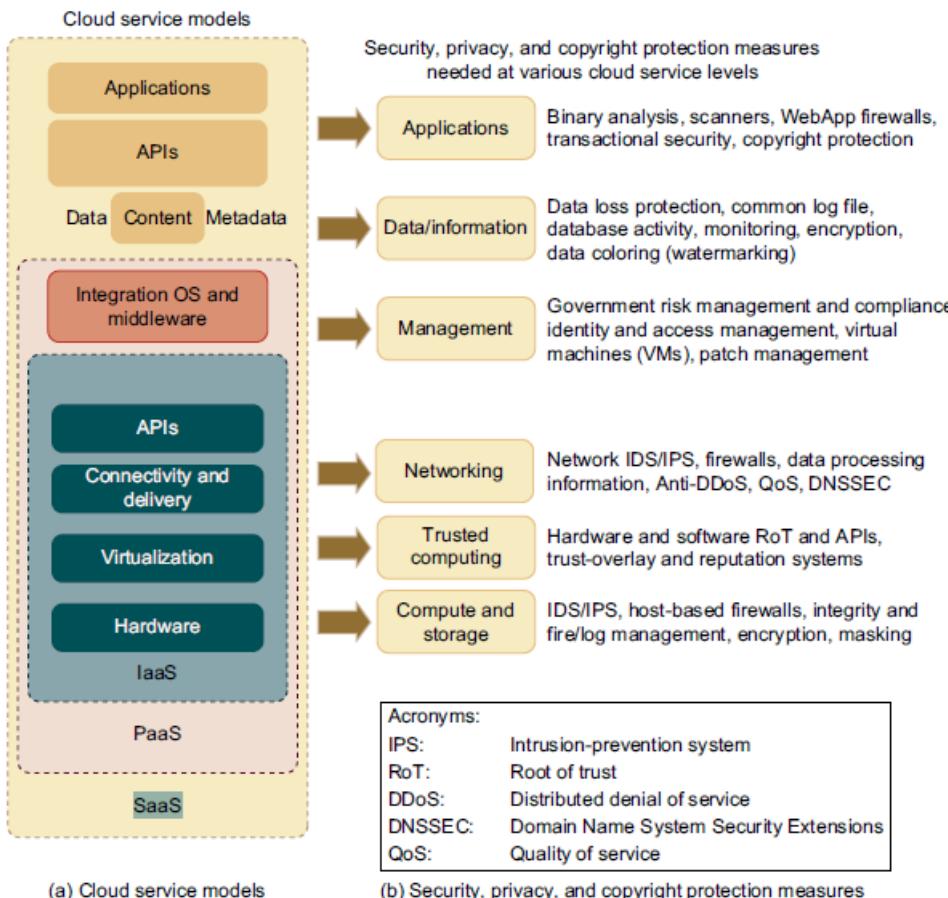
Zoho Cliq
Zoho Cliq helps you collaborate with your sales team in real time through instant chat, audio, or video. Share CRM records in direct messages or Cliq channels and discuss your prospects and deals from anywhere.

Zoho Meeting
Host a one-on-one session or a meeting with up to 50 participants, with crystal-clear audio, face-to-face video, and high-quality screen sharing. Keep track of the product demos you're giving to your leads and contacts in CRM's Events module.

Zoho ShowTime
Create and deliver engaging sales presentations to your leads and contacts. Once deals are completed, conduct training programs for your new customers no matter where they are. Zoho CRM is automatically updated with key customer information such as training sessions attended, customer engagement levels, and registration dates.

(featured cross-selling solutions during the Covid-19 pandemic)

Cloud Security – Different Measures on Different Levels



■ Left side (a)

- **Cloud service models including key functions**

■ Right side (b)

- **Corresponding security measures & technology**

- **Cloud security includes security, privacy, and copyright protection measures at various cloud service levels (IAAS, PAAS, SAAS) with different functionality to establish trust in customers / clients**
- **Cloud security also includes aspects of ‘trust in clouds’ related to national laws**

Cloud Security – National Boundaries Example & ‘Data lock-in’

■ Software portability

- Software stacks have **improved interoperability** among cloud platforms
- Key problem is still that APIs are still proprietary in many cases

[19] [wired.com ‘Patriot Act’](#) (**‘safe harbour’** in EU & General Data Protection Regulation – GDPR – are discussions related to this challenge)

■ Data ‘lock-in’

- Customers cannot easily extract their data from one SaaS provider in order to use the data with another SaaS provider (e.g. from Zoho to Salesforce)
- Key concern is loss of all data due to the failure of a single SaaS company

The General Data Protection Regulation (GDPR) is a regulation in EU law on data protection and privacy in the European Union (EU) and the European Economic Area (EEA). It also addresses the transfer of personal data outside the EU and EEA areas.

■ Lack of Standardization

- Standardize APIs so that SaaS developers can offer services that are able to access data across multiple SaaS cloud providers (e.g. data migration)

- Many nations have laws requiring SaaS providers to keep customer data used for business purposes and copyrighted material within national boundaries or have laws impacting trust
- US Patriot Act: U.S. law enforcement and intelligence organizations are able to obtain and examine European data stored in cloud offerings particularly SaaS solutions used worldwide
- Many SaaS cloud providers including also mostly the market leaders, fall within the U.S. jurisdiction either because they are U.S. companies or conduct systematic business in the U.S.

[37] [Wikipedia ‘GDPR’](#) [37] [Wikipedia ‘Safe Harbor’](#)

The International Safe Harbor Privacy Principles or Safe Harbour Privacy Principles were principles developed between 1998 and 2000 in order to prevent private organizations within the European Union or United States which store customer data from accidentally disclosing or losing personal information.

Advanced Collaboration Features

■ New forms of interactions through SAAS vs. traditional software

- Integrated collaborative and ‘social’ functionality (i.e. ‘share’, ‘like’)
- Inspired by success of online social networks and Web 2.0 (i.e. ‘live comments’)
- Enable ad-hoc collaboration between users and sharing of information (inside/outside organization)



ZOHO CRM

[17] ZOHO CRM Web page

■ Traditional example: 1 Word text with 2 users

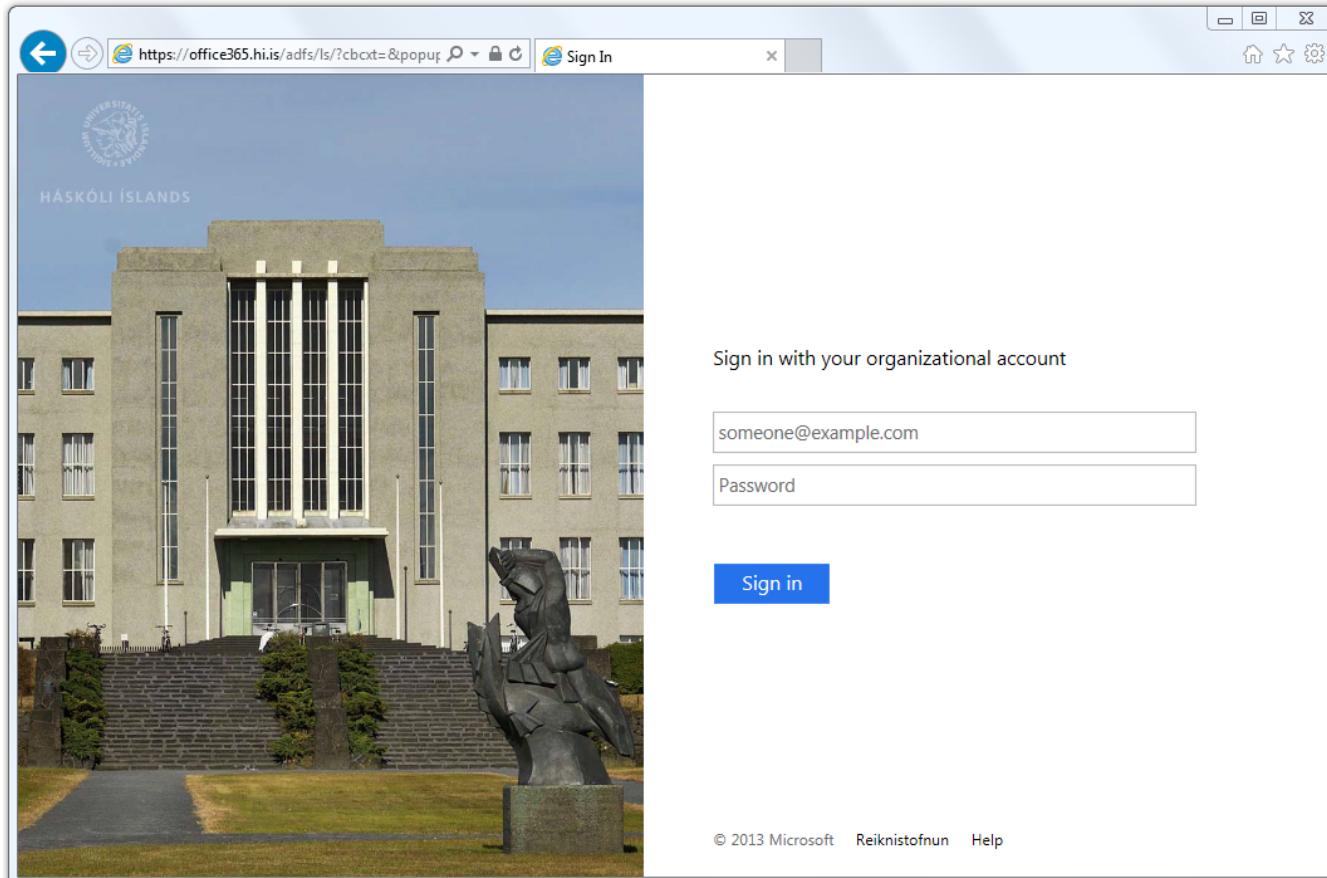
1. Write text
2. Send email to other
3. Wait for reply – other comments
4. Receive email from other
5. Work on comments → 1.



The screenshot shows the ZOHO CRM web interface. At the top, there's a navigation bar with 'All Contacts' and a search bar labeled 'FILTER CONTACTS BY'. Below this is a section for 'Activities' with a checkbox. A contact card for 'Morris' is shown as 'Available'. The main area displays a list of contacts with icons for each. On the right, a sidebar titled 'Chats' shows a message: 'The conversations you have with people and teams will appear here. You can click on a Contact or a Channel to participate in a conversation.' At the bottom, there are navigation buttons for 'Chats' and 'Contacts'.

➤ Lecture 14 provides more insights into Online Social Networking & Related Cloud Business Activities including Graph Databases

Microsoft Office 365 SAAS – University of Iceland Example



Office 365 →

Apps

- | | |
|------------|----------|
| Outlook | OneDrive |
| Word | Excel |
| PowerPoint | OneNote |
| SharePoint | Teams |
| Sway | Forms |

All apps →

Documents

- New ▾
- Notes and Progress
Morris Riedel's OneDrive for Business > ...



[20] Office 365 Uolceland

Microsoft Office 365 SAAS – Comment/Share/Joint Editing in Word

The screenshot shows the Microsoft OneDrive interface. At the top, there's a navigation bar with links for 'Office 365', 'OneDrive', and 'Shared with me'. Below this is a search bar and a sidebar with options like 'Morris Riedel', 'Files', 'Recent', 'Shared with me' (which is selected), 'Discover', 'Recycle bin', 'Get the OneDrive apps', and 'Return to classic OneDrive'. The main area displays a file named 'BMW CoCom-Regio' shared by 'Matthias Book' 16 days ago.



[20] Office 365 Uolceland

The screenshot shows the Microsoft Word Online interface. The title bar says 'Word Online'. The ribbon includes 'FILE', 'HOME', 'INSERT', 'PAGE LAYOUT', 'REVIEW', 'VIEW', and 'Tell me what you want to do'. The 'HOME' tab is selected. The main content area contains a paragraph of text about machine learning and case management. On the right side, there's a 'Comments' pane with a message from 'Morris Riedel' at 1:09 PM: 'Matthias, here we need to refine what algorithms we need for machine learning from my side'. The bottom of the screen shows page navigation and document statistics: 'PAGE 3 OF 10', 'ABOUT 4735 WORDS', 'GERMAN (GERMANY)', '100%', and 'HELP IMPROVE OFFICE'.

- **SAAS offerings include an increasing amount of collaborative functionality starting from sophisticated comment and voting functions on shared information & documents to chats and ad-hoc telcos**

Google SAAS Workspace Solutions – Selected Examples

■ Example: Google Docs

- Offers document suite that is free for anyone to use
- Creating a Google account is free and gives access
- Provides instant access to a word processor, spreadsheet application, presentation creator, etc.
- Enables collaborative work for many concurrent users (e.g. comments and observing joint edits, writings in parallel on paragraph level, etc.)
- Managed directly from the Web browser (no installation, no payment)



[21] Google Docs

■ Example: Google Drive

- Stores and shares files/folders
- Monthly fees based on volume

The landing page for Google Drive. It features the Google logo at the top left, followed by navigation links for Overview, What's included, Pricing, Security, and Resources. On the right are buttons for Admin console, Contact sales, and Get started. The main area shows a laptop displaying the Google Drive interface, with a small notebook icon to its right. To the right of the laptop is the Google Drive logo and a brief description: "Store, access, and share your files in one secure place. Store any and every file. Access files anytime, anywhere from your desktop and mobile devices. Control how files are shared." A "Get started" button is located at the bottom right of this section.

■ Example: Google Mail

- Provides E-Mail client (fees / volume)



[23] Google Gmail

[22] Google Drive

Google Maps SAAS with Ads Revenue Channel – Geographical Location Examples

coffee

Rating ▾ Hours ▾ More filters

Te & Kaffi Ad • 4.0 ★★★★★ (19)
\$S · Coffee shop · Kringslan
Open until 6:30 PM

Kaffitár Ad • 4.7 ★★★★★ (25)
Coffee shop · Borgartún 12
Open until 5:00 PM

Te & Kaffi
4.0 ★★★★★ (19)
\$S · Coffee shop · Kringslan
Open until 6:30 PM

Reykjavík Roasters
4.6 ★★★★★ (282)
\$S · Café · Brautarholt 2
Open until 5:00 PM

"Coffee was quite good. I had a flat white and it was well foamed."

Showing results 1 - 20

Update results when map moves

Satellite

Videy

Café Rosenberg

MIÐBORG

Nauthólvík Geothermal Beach

Reykjavík Roasters

Kaffitar, Kringslan

Te & Kaffi

Te & Kaffi

Gufunes Cemetery

Map data ©2020 Iceland Terms Send feedback 500 m

➤ Lecture 14 provides more insights into Online Social Networking & Related Cloud Business Activities including Google Adwords/Adsense

Conga SAAS – ‘Niche Markets’ Example

■ Example Conga Novatus

- SAAS solution for **online contract management solution**
- Allows to administer all aspects of the **contract lifecycle**
- **Enables contract creation** using company standard agreements
- **Supports negotiating** in a secure environment (i.e. collaboration)
- Provides functionality to **compare revisions and routing tasks**

The screenshot shows the Conga Novatus web interface. At the top, there's a navigation bar with links for MyPlace, Companies, Contracts, Reports, Admin, and Guest. Below the navigation is a search bar. The main content area has several sections:

- Charting - Agreement Types:** A pie chart showing the distribution of agreements by type: Statement of Work (green), Schedule (blue), Individual (red), and Amendment (orange).
- Recently Viewed Contracts:** A table listing contracts with columns for Company Name, Contract Number, Contract Group, Contract Status, and Agree.
- Recently Viewed Companies:** A table listing companies with columns for Company Name, Company Number, Company Group, and Company Status.
- Document Packages:** A section for managing document packages, showing items like 'Checked Out', 'Submitted', and 'Completed'.
- My Approvals:** A section for tracking approvals, showing items like 'Open' and 'Novatus, Incorporated - NDA eSignature Package'.

[27] Conga Novatus Web page

- Highly specialized software traditionally hard to sell in physical software stores, large malls, etc.
- Internet-based SAAS offers a big chance for niche market products (e.g. highly specialized software)

The Conga website homepage features a red circular logo with the word 'conga' in white. To its right, a circular graphic contains the text 'FORTUNE 41% OF THE FORTUNE 100 RELY ON CONGA'. The main content area includes:

- A banner with the text 'Get intelligence that gets results.'
- A photograph of a man in a red plaid shirt working at a desk.
- A call-to-action button 'Get a demo'.
- A yellow banner at the bottom with the text 'Let AI power your transformation.'

Using IAAS & PAAS for SAAS – AWS & Computing Aided Engineering Example

- Example: Amazon Web Services (AWS)
 - Provides IAAS & PAAS (cf. Lecture 8 & 9)
 - Offers companies who develop SAAS tools and delivery model a **special partner program**

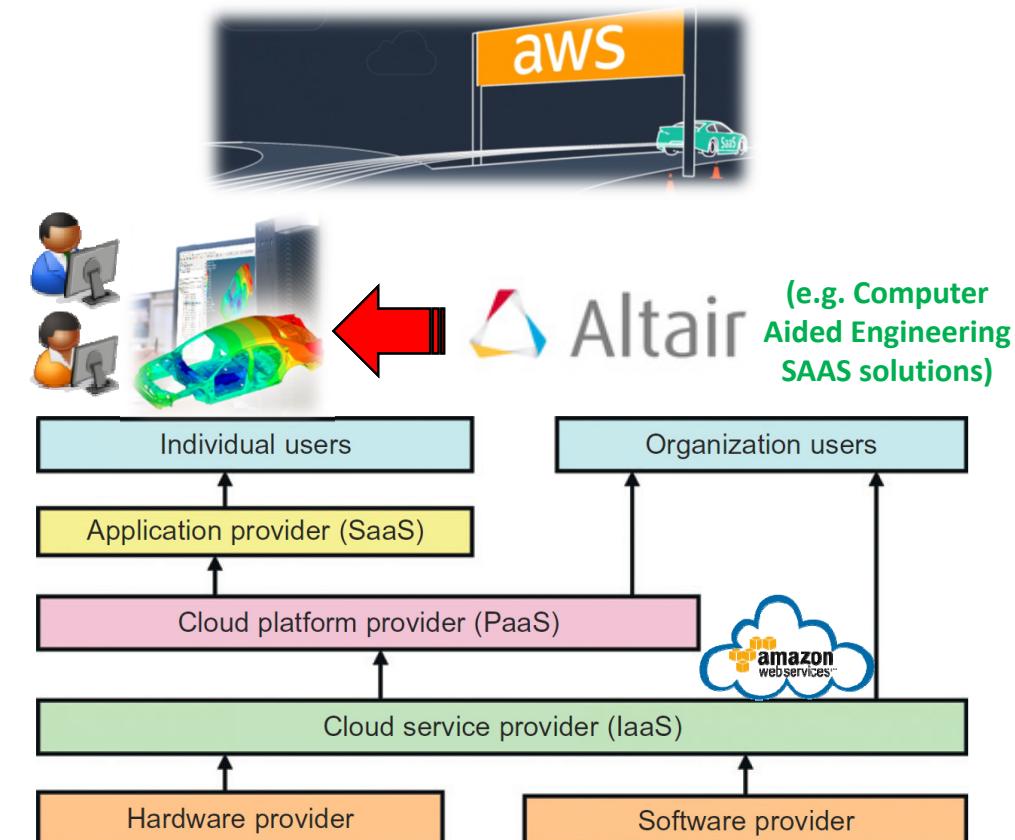


[24] AWS SAAS Factory Program

- Infrastructure layer with IAAS serves as the foundation for building the platform layer of the cloud supporting PAAS services
- Platform layer with PAAS in turn is a foundation for implementing the application layer for SAAS applications
- Different types of cloud services like Computer Aided Engineering (CAE) demand application of these resources separately

[2] Distributed & Cloud Computing Book

[25] Altair Engineering



➤ The complementary High Performance Computing (HPC) Course offers more insights into computer aided engineering & related topics

UberCloud – Cloud for Engineers offering SAAS Toolsets – UberCloud Containers

The screenshot shows the UberCloud homepage. At the top, there's a navigation bar with links for "HOW IT WORKS", "SOLUTIONS", "RESOURCES", "BLOG", "CONTACT", and "SUBSCRIBE TO NEWSLETTER". Below the navigation is a large image of a man with a beard looking at a computer screen displaying simulation data. The text "UberCloud Brings Your Simulations To The Cloud" is overlaid on the image. Below the image, the text "Implement and operate HPC infrastructure in your own cloud." is visible.

This screenshot shows the UberCloud self-service platform interface. It displays a grid of software toolsets with their versions and "CREATE" buttons. A red box highlights the first row of ANSYS tools: ANSYS v2019R3, ANSYS v2019R2, ANSYS v2019R2, ANSYS EM v2019R3, and ANSYS. Other toolsets shown include Abaqus CAE v2019, CST v2019, CST v2020, COMSOL v5.5, Star-CCM v14.06.013, Matlab v2019B, and MATLAB.

UberCloud HPC Platform

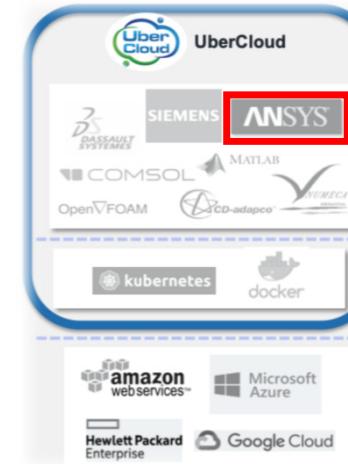
- Setup a full HPC self-service platform within your own Cloud account.
- Uses proprietary container technology to resolve the deployment challenges of technical computing environments.
- Gives design engineers HPC to increase engineering productivity and shorten project cycles.

[26] [UberCloud Web Page](#)



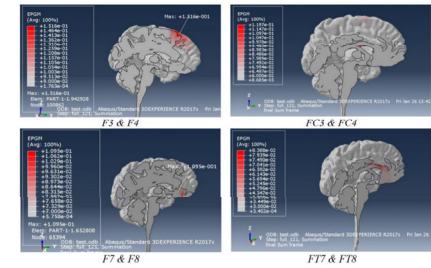
UberCloud Containers

UberCloud's container technology runs on Advania Data Centers and provides several scientific and technical computing applications. These HPC software containers run in a fully automated multi-node HPE environment in the Advania Data Centers' HPC Cloud.



Ansys

Ansys is a simulation pioneer that helps you solve the most challenging engineering problems. Access UberCloud's pre-packaged Ansys cloud solution with a secure browser connection and visualize a fully interactive desktop environment. Solve using **Mechanical**, **CFX**, **Fluent**, **IcePak**. Access powerful Ansys GUI tools such as **Workbench** for iterative analysis, and **Ansys Discovery Live** for real time simulations. Create on-demand clusters to execute batch or background jobs when needed.



➤ Lecture 12 will offer insights into different container management technologies like Docker, Singularity and UberCloud Containers

European Open Science Cloud (EOSC) – Public Storage & ‘Big Data’ SAAS

■ European Open Science Cloud (EOSC)

- EU EOSC-Nordic project in Iceland: provisioning of a couple of data services for selected application communities in Iceland
- Many different service providers for ‘big data’



[9] EOSC Web page



[10] EOSC-Nordic

The screenshot shows a grid of service cards from the EOSC Web page:

- MetaCentrum Cloud**: Czech national scientific cloud. Provided by: ČEZNET. Research area: Engineering and Technology, Humanities, Interdisciplinary. Dedicated for: Researchers, Research organizations, Research group.
- cPouta**: Cloud platform for science. Provided by: CZ. Research area: Interdisciplinary. Dedicated for: Researchers, Projects, Research groups, Business, Research organizations.
- Open Telekom Cloud**: Simple, secure and affordable European alternative public cloud, based on OpenStack. Provided by: T-Systems International GmbH. Research area: Interdisciplinary. Dedicated for: Researchers, Research organizations.
- eTDR - European Trusted Digital Repository**: eTDR services ensure that research digital data remains FAIR over time. Provided by: CINES. Research area: DataArchives, Engineering and Technology, Infrastructure development. Dedicated for: Researchers, Research organizations, Researchers.
- B2STAGE**: Transfer of data between data resources and external computational facilities. Provided by: EGI. Research area: CD Level 1 providers. Research area: Interdisciplinary. Dedicated for: Researchers, Research organizations.
- B2SAFE**: Distribute and store large volumes of data based on data policies. Provided by: EGI. Research area: Interdisciplinary. Dedicated for: Researchers, Research organizations.

[11] EC Expert Group on FAIR data final report modified for [12] Go-Fair Initiative

- The European Open Science Cloud (EOSC) provides services and tools for large-scale datasets (aka ‘big data’) for European researchers
- Increasing momentum for EOSC that is centrally based on making data (F)indable, (A)ccessible, (I)nteroperable, and (R)eusable (FAIR) like the Internet of FAIR Data and Services (IFDS) that provides services where machines and people can find and reuse each other’s research objects under optimal and well-defined conditions
- EOSC-Hub offers for Researchers a wide selection of cost-free services for Data Management, Data Sharing, Annotation, Compute, Storage, and Discovery based on Metadata, as well as processing and analysis tools under one federated identity security system

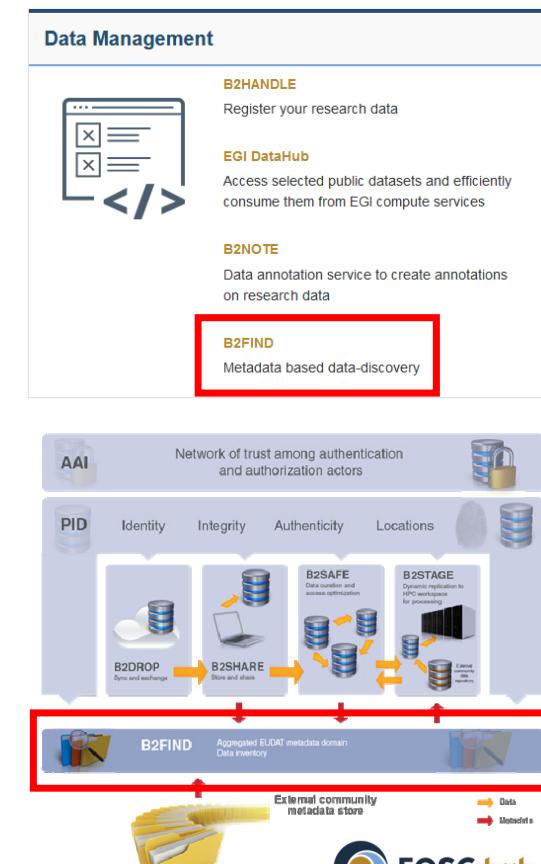
The screenshot shows the EOSC Portal interface:

- EUROPEAN OPEN SCIENCE CLOUD** logo
- ACCESS EOSC SERVICES & RESOURCES** section with icons for Networking, Compute, Storage, Sharing & Discovery, Data Management, Processing & Analysis, Security & Operations, and Training & Support.

EOSC – Hub Services for Researchers – Data Management Example

■ Added Value

- **B2FIND Discovery service based on metadata** steadily harvested from research data collections from EUDAT data centres and other repositories



 Collaborative
EUDAT Data Infrastructure
Data shared and preserved across borders and disciplines

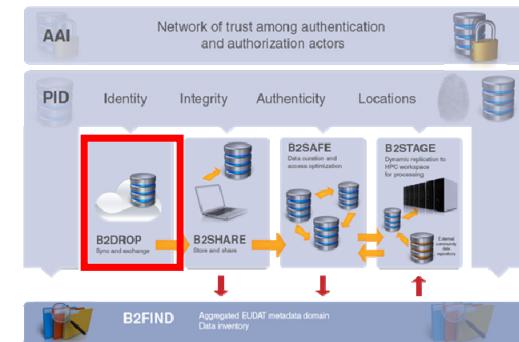
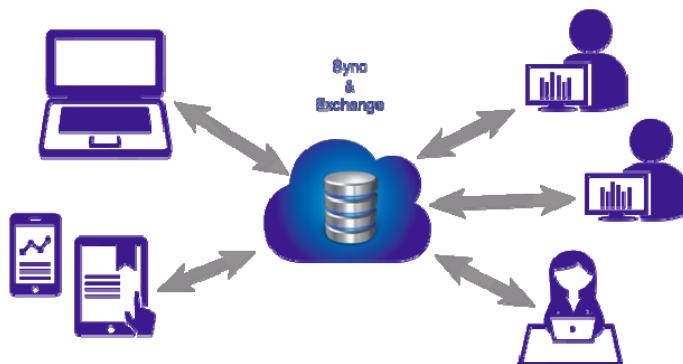
[30] B2FIND

 **EOSC-hub**
[29] EOSC-Hub

EOSC – Hub Services for Researchers – Data Sharing Example

■ Added Value

- **B2DROP** is a secure and trusted data exchange service for researchers and scientists to keep their research data synchronized and up-to-date and to exchange with other researchers
- Aka ‘Dropbox for science & engineering’



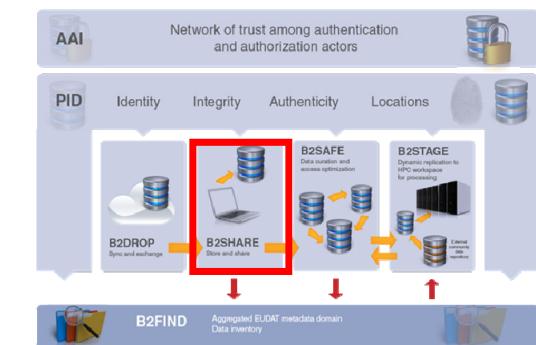
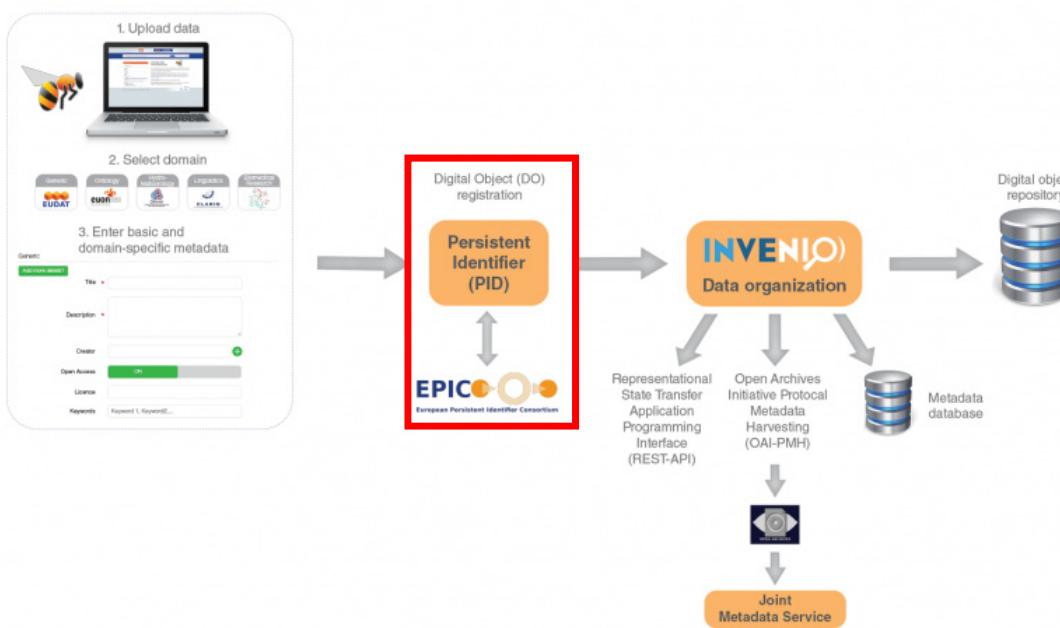
 Collaborative
EUDAT Data Infrastructure
Data shared and preserved across borders and disciplines



EOSC – Hub Services for Researchers – Data Storage & Publish Example

■ Added Value

- B2SHARE is a user-friendly, reliable and trustworthy way for researchers, scientific communities and citizen scientists to store and share small-scale research data from diverse contexts



**Collaborative
EUDAT Data Infrastructure**
Data shared and preserved across borders and disciplines

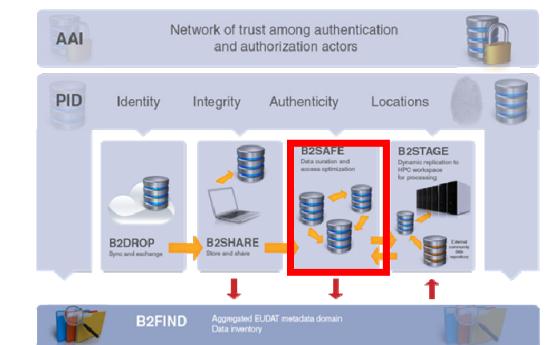
[32] B2SHARE

EOSC-hub
[29] EOSC-Hub

EOSC – Hub Services for Researchers – Data Storage Example

■ Added Value

- B2SAFE is a robust, safe and highly available service which allows community and departmental repositories to implement data management policies on their research data across multiple administrative domains in a trustworthy manner



 Collaborative
EUDAT Data Infrastructure
Data shared and preserved across borders and disciplines

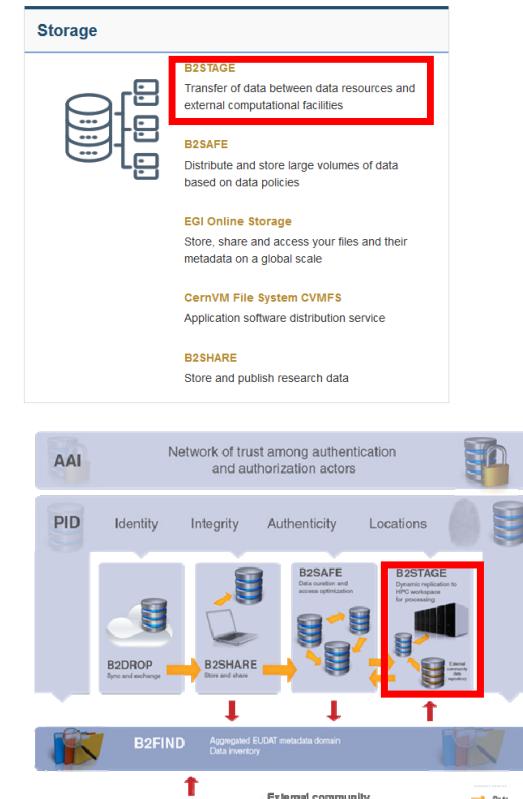
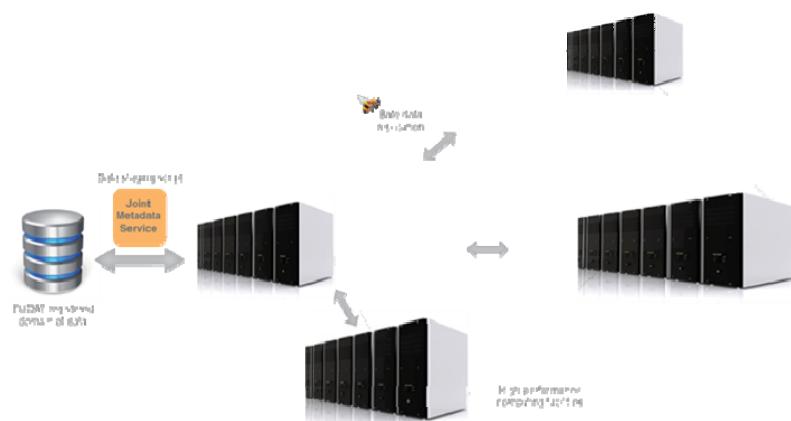
[33] B2SAFE

 **EOSC-hub**
[29] EOSC-Hub

EOSC – Hub Services for Researchers – Data Transfer Example

■ Added Value

- B2STAGE is a reliable, efficient, light-weight and easy-to-use service to transfer research data sets between EUDAT storage resources and high-performance computing (HPC) workspaces



EOSC Nordic Cloud FAIR Activities in the Nordic Countries & Close Partners

Knowledge Hub → Training Library

Training Library

The training library brings together all sorts of training materials in the form of webinars, videos, articles, and more.

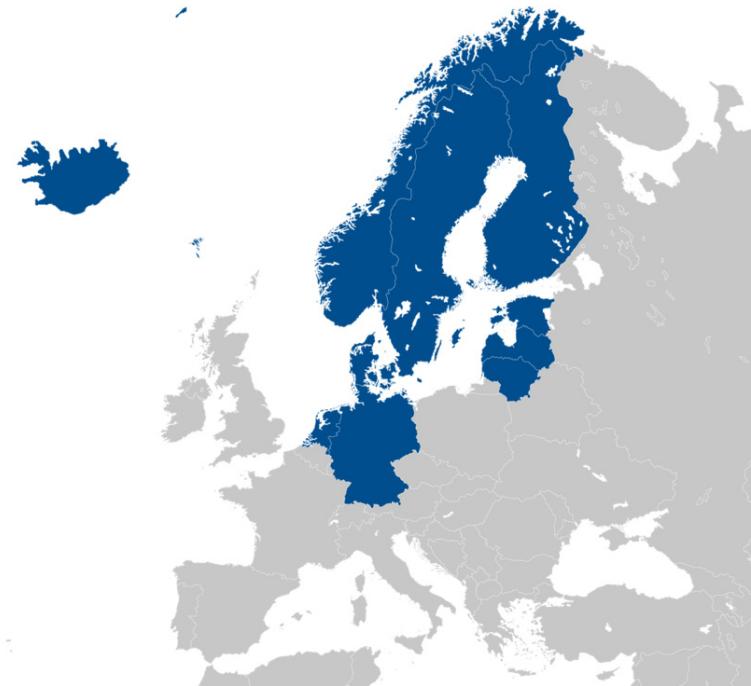
Background paper on workshop 'FAIRification of Nordic+Baltic data repositories'	22.04.2020	Document
FAIR & FAIR Implementation Strategies	22.04.2020	Presentation
FAIR & FAIR implementation strategies (recording)	22.04.2020	Video
FAIRification of Nordic + Baltic data repositories	22.04.2020	Presentation
Fairification of Nordic and Baltic data repositories (recording)	15.04.2020	Video
Next steps for FAIRification of repositories (22.4.2020)	22.04.2020	Presentation
Recommendations for FAIR Evaluation Services, based upon the FAIR Maturity Evaluation Service	22.04.2020	Document
WORKSHOP FAIRification NORDIC / BALTIC 22.04.2020	22.04.2020	Presentation

EOSC-Nordic Partners

- NelC (NordForsk)
- DeiC (DTU)
- Computerome – National Life Science Supercomputing Center (DTU)
- IT Center for Science (CSC)
- Uninett Sigma2
- Swedish National Infrastructure for Computing (University of Uppsala) (SNI)
- University of Tartu (UT/ Estonian Scientific Computing Infrastructure – ETAIS)
- University of Iceland (UICE)
- University of Vilnius (VU)
- Riga Technical University (RTU)
- The University of Southern Denmark (SDU)
- NORDUnet
- Swedish Research Council (Vetenskapsrådet) (SUNET)
- University of Helsinki
- National Institute of Chemical Physics and Biophysics (KBF/ET AIS)
- Tampere University (UTA/FSD)
- University of Gothenburg (SND/GGBC)
- Norwegian Centre for Research Data (NSD)
- Danish National Archives (DNA)
- Finnish Meteorological Institute (FMI)
- University of Eastern Finland (UEF)
- Go Fair Foundation (GFF)
- German Climate Computing Centre (DKRZ)
- University of Copenhagen (UCPH)
- The Capitol Region of Denmark (RH)



[10] EOSC-Nordic



SAAS Reflections – Selected Disadvantages of the Approach

■ Required perfect Internet connection (e.g. no offline task lists)

- More SAAS applications are used in parallel for many purposes require massive bandwidth in combination with ever increasing functionality
- E.g. using ZOHO for CRM process while looking at Facebook news...

■ Critic: Service as a Software Substitute (SaaSS)

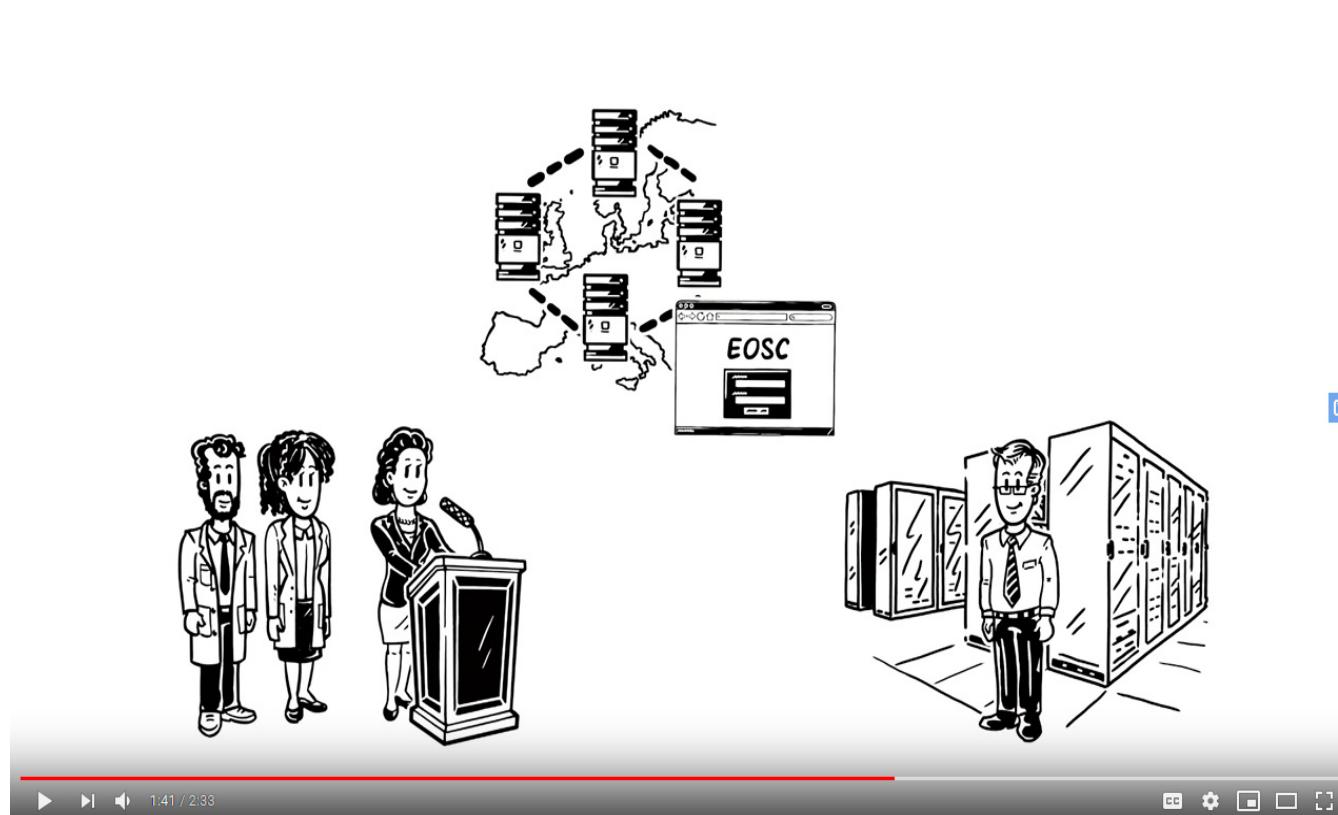
- Use of SAAS might be seen as violation of the principles of free software
- E.g. not even the executable is accessible for users anymore – a blackbox

■ Need for SAAS data escrow

- Data ‘lock-in’, once data is over years inside on SAAS, migration hard
- SAAS data escrow refers to a process of keeping a copy of critical SAAS application data with an independent third party
- E.g. secure against vendor bankruptcy or protecting against data loss

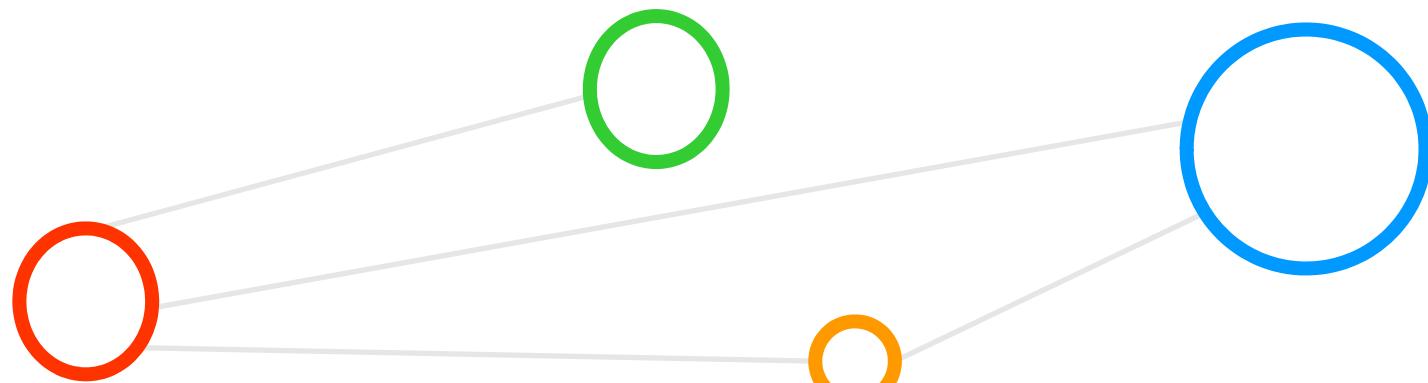
- Disadvantages of the SAAS-based model includes the need for a perfect internet connection, the problem of Service as a Software Substitute (SaaSS), and need for SAAS data escrow

[Video] European Open Science Cloud (EOSC) – Summary & Bigger Picture



[28] YouTube video, *The European Open Science Cloud (EOSC) explained by the ZBW*

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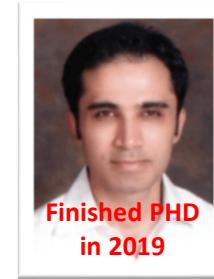
Acknowledgements – High Productivity Data Processing Research Group



Finished PhD
in 2016



Finishing
in Winter
2019



Finished PhD
in 2019



Mid-Term
in Spring
2019



Started
in Spring
2019



Started
in Spring
2019

Morris Riedel @MorrisRiedel · Feb 10
Enjoying our yearly research group dinner 'Iceland Section' to celebrate our productive collaboration of @uni_iceland @uisens @Haskell_Islands & @fz_jsc @fz_juelich & E.Erlingsson @emrie passed mid-term in modular supercomputing driven by @DEEPprojects - morrisriedel.de/research

A photograph showing several people seated around tables in a restaurant. Some are wearing academic caps and gowns. The setting is indoors with warm lighting and traditional Icelandic decorations on the walls.

Finished PhD
in 2018



MSc M.
Richerzhagen
(now other division)



MSc
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(now INM-1)



MSc
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