

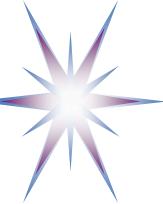


# Big Data Infrastructure and Technologies for Data Analytics (BDIT4DA)

## Practice 1 Guidelines

Getting Started with AWS:  
EC2, S3, Monitoring with CloudWatch  
Lambda

Dr. Yuri Demchenko  
University of Amsterdam



# Outline

- Setting up your AWS Educate account (skip if you're not part of a university course)
- EC2
  - Creating webserver on VM instance (deploying LAMP server)
- Configuring SSH client for
- S3
- Adding monitoring to EC2 and S3
- Lambda
- Setting up CLI environment



# Accepting invitation and “Go to classroom”

Screenshot of the AWS Educate student portal showing the "My Classrooms" section.

The top navigation bar includes "Sign out", "Thread: DS Drafts and discussio...", "My Classrooms", and other tabs like "Workbench". The URL is https://www.awseducate.com/student/s/classrooms.

User profile information: Alex Demch, Consecutive Days: 1, Pathways Completed: 0, Badges Earned: 0, Preferred Language: English.

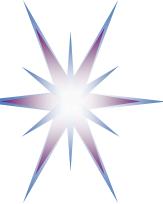
## My Classrooms

View your list of Classroom invitations and accept or decline the invitation. Access a Classroom by clicking Go to my classroom.

Course Name	Description	Educator	Course End Date	Credit Allocated Per Student	Status
Big Data Infrastructure Technologies for Data Analytics (BDIT4DA)	This course provides overview and introduction into the Big Data infrastructure technologies and tools. It establishes working knowledge of the concepts, techniques and products associated with the Big Data infrastructure and corresponding cloud based services. The focus is given on the cloud based Big Data infrastructure and analytics solutions and how cloud based services can be integrated into company's IT and data infrastructure, in particular providing deep insight into the AWS Big Data and ML services Students will learn the core functionality of the major Big Data Infrastructure components and how they integrate to form a coherent solution with business benefit. Hands-on exercises aim to provide insight into how the cloud based services and tools can simplify processing of Big Data by using cloud based services for Hadoop, Machine Learning and general data analytics.	Yuri Demchenko	03/31/2021	\$50	Accepted <a href="#">Go to classroom</a>

A modal window is open for the BDIT4DA course invitation:

Educator	Course End Date	Credit Allocated Per Student	Status
Yuri Demchenko	03/31/2021	\$50	<a href="#">Accept Invitation</a> <a href="#">Decline</a>



# Setting up AWS Educate Class account (Optional if you have already)

Sign out X awseducate.com/Registration?token=dcffb5c112363 +

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## Step 2/3: Tell us about yourself

Preferred Language: English

NTUU "Kiev Polytechnic Institute"  
Start typing the name of your school and select from the list. If you don't see your school, enter the full name, example: Harvard University

Kiev

Ukraine

Alex

Dobrovolski

Computer Science

alexd@chello.nl  
Please provide a valid, current email issued by your institution. Example: your\_name@your\_school.edu

Graduate

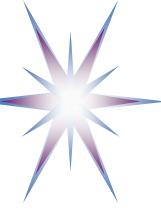
11

2019

5

1996

Promo Code



# Setting up AWS Educate Class account

The screenshot shows two browser windows side-by-side. The left window displays 'Step 3/3: Choose one of the following' with two options: 'Click here to enter an AWS Account ID' (with a green arrow pointing to it) and 'Click here to select an AWS Educate Starter Account'. The right window displays 'Step 2/3: Tell us about yourself' with fields for 'Preferred Language' (set to English), 'School Name' (NTUU "Kiev Polytechnic Institute"), 'Country' (Ukraine), 'State' (State where your school is located), 'City' (Dobrovolski), 'Email' (alex@chello.nl), and 'Graduate Year' (5 and 1996). A red bullet point at the bottom right of the right window states: 'Be sure to put graduate date later than course will finish'.

Sign out [awseducate.com/Registration?token=dcffb5c11236](https://www.awseducate.com/Registration?token=dcffb5c11236) +

Most Visited LENS Liverpool Student Portal Liv - Dissertation Contracts Faculty Reviews LOE-DS BD2018 BD2017 Dashboard - Microsoft...

Step 2/3: Tell us about yourself

Preferred Language: English

NTUU "Kiev Polytechnic Institute"  
Start typing the name of your school and select from the list. If you don't see your school, click here to enter an AWS Account ID

Ukraine

State (where your school is located)

Dobrovolski

alex@chello.nl  
Please provide a valid, current email issued by your institution. Example: your\_name@your\_school.edu

Graduate

5 1996

Step 3/3: Choose one of the following

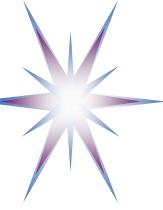
Click here to enter an AWS Account ID  
Approved students are sent a welcome email and benefits including an AWS promotional code.  
Don't have one? Sign up now

Click here to select an AWS Educate Starter Account  
An AWS Educate Starter Account is a free, capped-account that doesn't require a credit card. There are some usage limitations including an approximately 25% reduction in access to AWS services. Because Starter Accounts are capped, a separate AWS promotional code is not provided.  
Frequently Asked Questions

Please note that any personal information you provide will be treated in accordance with the [AWS Educate Terms and Conditions](#) and [AWS Privacy Notice](#)

NEXT

- Be sure to put graduate date later than course will finish



# Your AWS Educate Class Portal

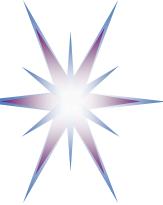
The screenshot shows the AWS Educate Class Portal interface. The main window displays the "Welcome to your AWS Educate Account" message. To the right, there's a sidebar titled "Your AWS Account Status" showing account status (Active), credits (\$4.99), and session time (2:20). Below this is a note about responsible usage. A modal window titled "Credentials" is open, providing AWS Access information and AWS CLI instructions. It includes a code block for the AWS CLI configuration file (~/.aws/credentials) with access key ID and secret access key.

**For AWS CLI: Copy and paste the following into `~/.aws/credentials`**

```
[default]
aws_access_key_id=ASIASIMUMGQYE3MY7LFR
aws_secret_access_key=185iEXycnjqCqhpOz1TD8AN/h5XY0sb7QBTikRKt
aws_session_token=FwoGZXIvYXdzENz//////////wEAADhExjMPUL17nSrQSK+AbqrJwb/30aG3HBge47BAAd7MnFsznYDqc2lDwNR1dCBTwMCTX1NdSz11rMjy4wXBiy/YSGqhODjn17+6y19WQ1WoAqeAxeBCQ1oedRvhU4RAHiFDe3nTd0pAj+j+PC6Hbhup1o/HH1/sx4JLZSRIsEzDsqt3lHa9doMLh/hTHgZduTfAV1Fl40N+4tOOTPlTWxajztYgvPPm1bBpcP9h2VojTxCEoefPjIlvyc1P78nvfaqVFFukeTuxCVUo1Ma29AUyLdOaF+4sTqoqBQqZ+R6VRKCIEohYzxgvmB9kwy41JDOPeolHIMO4+IyEhCLOug==
```

**• Copy private access key if you want to use AWS CLI tool**

**• This is beneficial if you want to automate AWS resources deployment (like deploying your ML model for using with the production data)**



# AWS Portal - Services

The screenshot shows the AWS Management Console Services page. At the top, there's a navigation bar with tabs for 'My Classrooms', 'Workbench', and 'AWS Management Con...'. Below the navigation bar is a toolbar with various icons and links. The main content area is titled 'Services' and 'Resource Groups'. It features a search bar with placeholder text 'Find a service by name or feature (for example, EC2, S3 or VM, storage)'. To the right of the search bar are buttons for 'Group' and 'A-Z'. The services are organized into several groups:

- Compute:** EC2, Lightsail, Lambda, Batch, Elastic Beanstalk, Serverless Application Repository, AWS Outposts, EC2 Image Builder.
- Storage:** S3, EFS, FSx, S3 Glacier, Storage Gateway, AWS Backup.
- Database:** RDS, DynamoDB, ElastiCache.
- Blockchain:** Amazon Managed Blockchain.
- Satellite:** Ground Station.
- Quantum Technologies:** Amazon Braket.
- Analytics:** Athena, EMR, CloudSearch, Elasticsearch Service, Kinesis, QuickSight, Data Pipeline, AWS Data Exchange, AWS Glue, AWS Lake Formation, MSK.
- End User Computing:** WorkSpaces, AppStream 2.0, WorkDocs, WorkLink.
- Internet Of Things:** IoT Core, FreeRTOS, IoT 1-Click, IoT Analytics, IoT Device Defender, IoT Device Management, IoT Events, IoT Greengrass, IoT SiteWise, IoT Things Graph.
- Management & Governance:** AWS Organizations, CloudWatch, AWS Auto Scaling, CloudFormation, CloudTrail, Config, OpsWorks, Service Catalog, Systems Manager, AWS AppConfig.
- Security, Identity, & Compliance:** IAM, Resource Access Manager, Cognito, Secrets Manager, GuardDuty, Inspector, Amazon Macie, AWS Single Sign-On, Certificate Manager.
- Game Development:** Amazon GameLift.
- Containers:** (represented by a building icon).

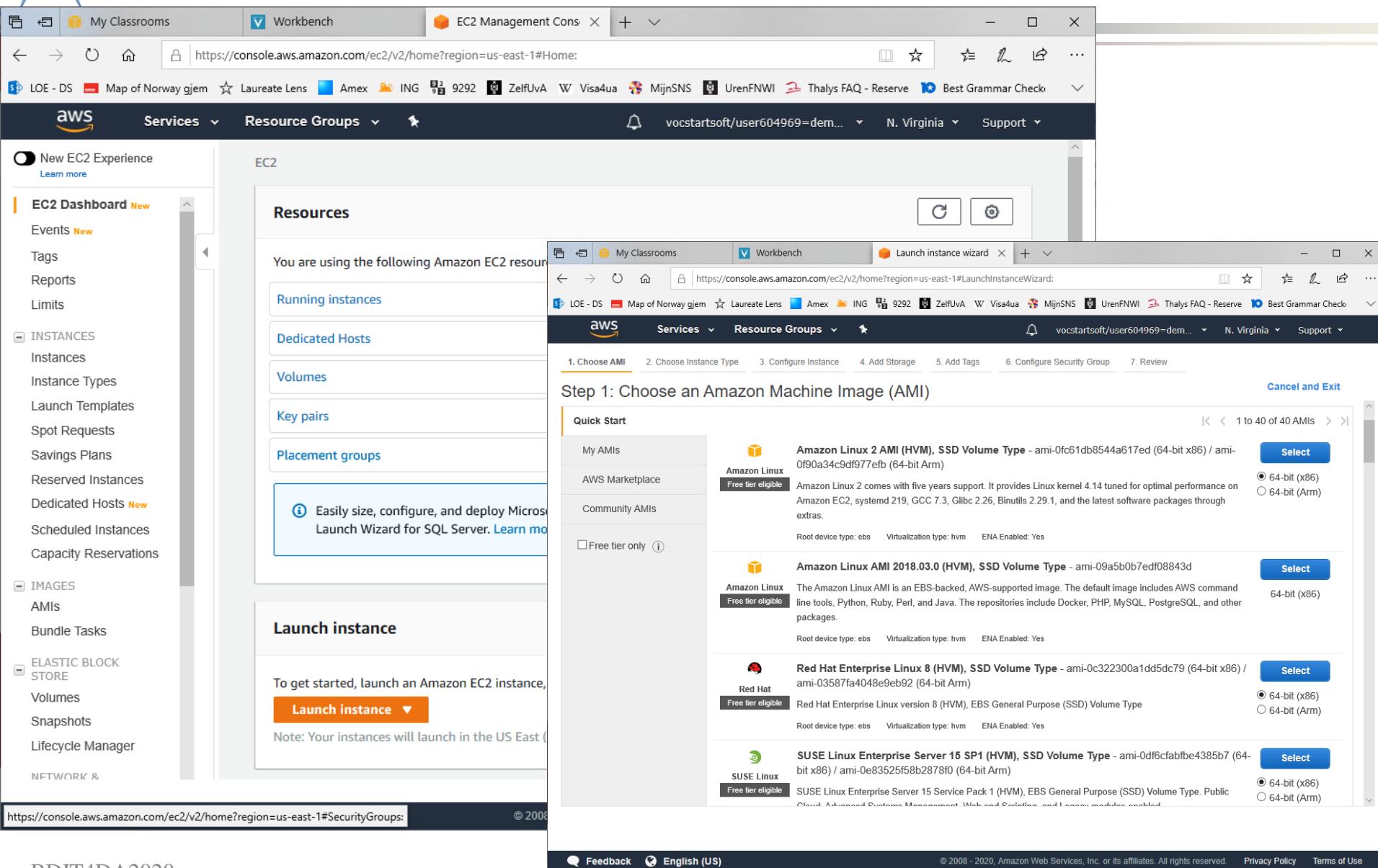
- Navigate through offered AWS cloud services
- Investigate services in each group Compute, Storage, Databases, Management, Security, Machine Learning, others



# Creating EC2 VM Instance



# Select your AMI configuration When launching new VM instance



The screenshot shows two overlapping browser windows. The top window is the AWS EC2 Management Console with the URL <https://console.aws.amazon.com/ec2/v2/home?region=us-east-1#Home>. The bottom window is the "Launch instance wizard" with the URL <https://console.aws.amazon.com/ec2/v2/home?region=us-east-1#LaunchInstanceWizard>.

**AWS EC2 Management Console (Top Window):**

- Services: EC2
- Resources: Resources
- Running instances, Dedicated Hosts, Volumes, Key pairs, Placement groups
- Launch instance wizard button
- Launch instance button

**Launch Instance Wizard (Bottom Window):**

1. Choose AMI
2. Choose Instance Type
3. Configure Instance
4. Add Storage
5. Add Tags
6. Configure Security Group
7. Review

**Step 1: Choose an Amazon Machine Image (AMI)**

Quick Start:

- My AMIs
- AWS Marketplace
- Community AMIs
- Free tier only

AMIs listed:

- Amazon Linux** (Free tier eligible) - ami-0fc61db8544a617ed (64-bit x86) / ami-0f90a34c9df977efb (64-bit Arm)
  - Select button
  - 64-bit (x86)
  - 64-bit (Arm)
- Amazon Linux AMI 2018.03.0 (HVM), SSD Volume Type** - ami-09a5b0b7edf08843d
  - Select button
  - 64-bit (x86)
  - 64-bit (Arm)
- Red Hat Enterprise Linux 8 (HVM), SSD Volume Type** - ami-0c322300a1dd5dc79 (64-bit x86) / ami-03587fa4048e9eb92 (64-bit Arm)
  - Select button
  - 64-bit (x86)
  - 64-bit (Arm)
- SUSE Linux Enterprise Server 15 SP1 (HVM), SSD Volume Type** - ami-0df6cfabfe4385b7 (64-bit x86) / ami-0e83525f58b2878f0 (64-bit Arm)
  - Select button
  - 64-bit (x86)
  - 64-bit (Arm)

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# AWS Marketplace offers 3<sup>rd</sup> party VMs

The screenshot shows the AWS EC2 Launch Instance Wizard. The user is on Step 1: Choose AMI. The interface includes a search bar at the top labeled "Search for an AMI by entering a search term e.g. "Windows"" and a sidebar on the left with links like "Quick Start", "My AMIs", "AWS Marketplace", and "Community AMIs". The main content area displays a list of available AMIs, with the first item being "Amazon Linux 2 (x86\_64) - ami-0f1a2a2a2a2a2a2a2". Below the search bar, there's a brief description of what an AMI is.

The screenshot shows the AWS Marketplace interface. The user is on the "AWS Marketplace" page, which features sections for "Featured Software" and "Popular Software". Under "Featured Software", there are three items: "Barracuda CloudGen Firewall for AWS", "Juniper vSRX Next Generation Firewall", and "WordPress with NGINX and SSL Certified by Bitnami and Automatic". Each item has a thumbnail, a title, a rating, and a "Select" button. The sidebar on the left lists categories such as "All Categories", "Infrastructure Software (2476)", "DevOps (1949)", "Business Applications (872)", "Machine Learning (109)", "IoT (92)", and "Industries (231)". The footer contains links for "Feedback", "English (US)", and "Privacy Policy".



# Go through instance configuration details: Start from selecting instance type (Micro types for education purposes)

[My Classrooms](#) [Workbench](#) [Launch instance wizard](#)

LOE - DS Map of Norway gjem Laureate Lens Amex ING 9292 ZelfUvA Visa4ua MijnSNS UrenFNWI Thalys FAQ - Reserve Best Grammar Check

AWS Services Resource Groups

1. Choose AMI 2. Choose Instance Type 3. Configure Instance 4. Add Storage 5. Add Tags 6.

## Step 2: Choose an Instance Type

Amazon EC2 provides a wide selection of instance types optimized to fit different use cases. Instances are CPU, memory, storage, and networking capacity, and give you the flexibility to choose the appropriate mix they can meet your computing needs.

Filter by: General purpose All generations Show/Hide Columns

Currently	All instance types	vCPUs, 0.613 GiB memory, EBS only		
	Micro instances	vCPUs	Memory (GiB)	Instance (GB)
	General purpose	1	0.5	
	Compute optimized	1	1	
	FPGA instances	1	1	
	GPU instances	1	1	
	Machine learning ASIC instances	1	1	
	Memory optimized	1	1	
	Storage optimized	1	1	
	General purpose	t2.small	1	2
	General purpose	t2.medium	2	4
	General purpose	t2.large	2	8

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- Pay attention to configuration details
- Select new or already created VPC and subnet
- Enable detailed CloudWatch monitoring
- Decide on tenancy option

BDIT4DA2020

My Classrooms Workbench Launch instance wizard

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Services Resource Groups

1. Choose AMI 2. Choose Instance Type 3. Configure Instance 4. Add Storage 5. Add Tags 6. Configure Security Group 7. Review

## Step 3: Configure Instance Details

Configure the instance to suit your requirements. You can launch multiple instances from the same AMI, request Spot instances to take advantage of the lower pricing, assign an access management role to the instance, and more.

Number of Instances 1 Launch into Auto Scaling Group

Purchasing option Request Spot instances

Network Loading... Create new VPC

Subnet No preference (default subnet in any Availability Zone) Create new subnet

Auto-assign Public IP Use subnet setting

Placement group Add instance to placement group

Capacity Reservation Open Create new Capacity Reservation

IAM role None Create new IAM role

Shutdown behavior Stop

Stop - Hibernate behavior Enable hibernation as an additional stop behavior

Enable termination protection Protect against accidental termination

Monitoring Enable CloudWatch detailed monitoring Additional charges apply.

Tenancy Shared - Run a shared hardware instance Additional charges will apply for dedicated tenancy.

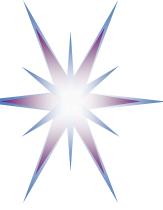
Elastic Inference Add an Elastic Inference accelerator Additional charges apply.

T2/T3 Unlimited Enable Additional charges may apply

File systems Add file system Create new file system

Cancel Previous Review and Launch Next: Add Storage

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# Add tags and Select Security Group: Use already created Security Group for your application

The screenshot shows two side-by-side browser windows for the AWS EC2 Launch Instance Wizard.

**Left Window (Step 5: Add Tags):**

- Header: My Classrooms, Workbench, Launch instance wizard
- Step 5: Add Tags
- Description: A tag consists of a case-sensitive key-value pair. A copy of a tag can be applied to volumes, instances, and snapshots. Tags will be applied to all instances and volumes.
- Form fields:
  - Key (128 characters maximum): purpose
  - Type: type
  - Add another tag (Up to 50 tags maximum)

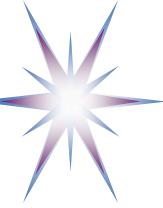
**Right Window (Step 6: Configure Security Group):**

- Header: My Classrooms, Workbench, Launch instance wizard
- Step 6: Configure Security Group
- Description: A security group is a set of firewall rules that control the traffic for your instance. On this page, you can add rules to allow specific traffic to reach your instance. For example, if you want to set up a web server and allow Internet traffic to reach your instance, add rules that allow unrestricted access to the HTTP and HTTPS ports. You can create a new security group or select from an existing one below. [Learn more](#) about Amazon EC2 security groups.
- Assign a security group:
  - Create a new security group
  - Select an existing security group
- Security group name: launch-wizard-1
- Description: launch-wizard-1 created 2020-04-08T13:50:20.197+02:00
- Table: Inbound Rules

Type	Protocol	Port Range	Source	Description
SSH	TCP	22	Custom 0.0.0.0/0	e.g. SSH for Admin Desktop

- Warning message: **⚠ Warning** Rules with source of 0.0.0.0/0 allow all IP addresses to access your instance. We recommend setting security group rules to allow access from known IP addresses only.
- Buttons: Cancel, Previous, Review and Launch

- Note: If you plan to deploy webserver, add inbound rules for ports HTTP/80 and HTTPS/443
- You can also change this later by modifying inbound rules for security groups
- Hint: Think about Security group as firewall



# Final Step 7 before launch

Screenshot of the AWS Launch Instance Wizard Step 7: Review Instance Launch.

The browser title bar shows "Launch instance wizard | E X". The URL is "https://console.aws.amazon.com/ec2/v2/home?region=us-east-1#LaunchInstanceWizard".

The AWS navigation bar includes "Sign out", "Thread: DS Drafts and dis...", "My Classrooms", "Workbench", and "Launch instance wizard".

The main content area shows the progress bar at Step 7: Review.

## Step 7: Review Instance Launch

Please review your instance launch details. You can go back to edit changes for each section. Click **Launch** to assign a key pair to your instance and complete the launch process.

**⚠ Improve your instances' security. Your security group, launch-wizard-1, is open to the world.**

Your instances may be accessible from any IP address. We recommend that you update your security group rules to allow access from known IP addresses only. You can also open additional ports in your security group to facilitate access to the application or service you're running, e.g., HTTP (80) for web servers. [Edit security groups](#)

**AMI Details** [Edit AMI](#)

**Ubuntu Server 18.04 LTS (HVM), SSD Volume Type - ami-00ddb0e5626798373**

**Free tier eligible** Ubuntu Server 18.04 LTS (HVM), EBS General Purpose (SSD) Volume Type. Support available from Canonical (<http://www.ubuntu.com/cloud/services>). Root Device Type: ebs Virtualization type: hvm

**Instance Type** [Edit instance type](#)

Instance Type	ECUs	vCPUs	Memory (GiB)	Instance Storage (GB)	EBS-Optimized Available	Network Performance
t2.micro	-	1	1	EBS only	-	Low to Moderate

**Buttons:** Cancel, Previous, Launch



# Launching AMI and downloading keypair

Step 7: Review Instance Launch

Amazon Linux AMI 2018.03.0 (HVM), SSD Volume Type - ami-09a5b0b7edf08843d

Free tier eligible

The Amazon Linux AMI is an EBS-backed, AWS-supported AMI. Its repositories include Docker, PHP, MySQL, PostgreSQL, and others.

Root Device Type: ebs Virtualization type: hvm

Instance Type

Instance Type	ECUs	vCPUs	Memo
t2.micro	Variable	1	1

Security Groups

Security group name	Description
launch-wizard-1	launched by wizard-1 created 2020-07-20T10:45:00Z

Type: SSH Protocol: TCP

Select an existing key pair or create a new key pair

A key pair consists of a **public key** that AWS stores, and a **private key file** that you store. Together, they allow you to connect to your instance securely. For Windows AMIs, the private key file is required to obtain the password used to log into your instance. For Linux AMIs, the private key file allows you to securely SSH into your instance.

Note: The selected key pair will be added to the set of keys authorized for this instance. Learn more about [removing existing key pairs from a public AMI](#).

Create a new key pair  
Key pair name: keypair2020bdit4da  
Download Key Pair

You have to download the **private key file (\*.pem file)** before you can continue. **Store it in a secure and accessible location**. You will not be able to download the file again after it's created.

Cancel Launch Instances

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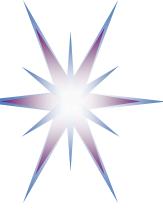
# Launching Spot Instances – Is not eligible to AWS Educate account

The screenshot shows the AWS Launch Instance Wizard at Step 7: Review Instance Launch. Two warning messages are displayed:

- ⚠ Improve your instances' security. Your security group, launch-wizard-2, is open to the world.**  
Your instances may be accessible from any IP address. We recommend that you update your security group rules to allow access from known IP addresses only. You can also open additional ports in your security group to facilitate access to the application or service you're running, e.g., HTTP (80) for web servers. [Edit security groups](#)
- ⚠ Your instance configuration is not eligible for the free usage tier**  
To launch an instance that's eligible for the free usage tier, check your AMI selection, instance type, configuration options, or storage devices. Learn more about [free usage tier](#) eligibility and usage restrictions.

In the AMI Details section, it shows an Ubuntu Server 20.04 LTS (HVM), SSD Volume Type - ami-0885b1f6bd170450c. A "Free tier eligible" badge is present. The status message indicates that Canonical support is available from <http://www.ubuntu.com/cloud/services>. Root Device Type: ebs and Virtualization type: hvm.

- Note: If not eligible, report this in your practice report



# VM Instance Overview

The screenshot shows the AWS EC2 Instances page. The left sidebar includes links for New EC2 Experience, EC2 Dashboard, Events, Tags, Reports, Limits, Instances (selected), Instance Types, Launch Templates, Spot Requests, Savings Plans, Reserved Instances, Dedicated Hosts, Scheduled Instances, Capacity Reservations, Images (AMIs, Bundle Tasks), Elastic Block Store (Volumes, Snapshots), and Network & Security (Security Groups). The main content area displays a single instance: i-0230615234265584f, which is a t2.micro instance running in us-east-1c. The instance has a Public DNS of ec2-18-233-97-213.compute-1.amazonaws.com and a Private DNS of ip-172-31-81-135.ec2.internal. It has an IPv4 Public IP of 18.233.97.213 and is associated with a VPC ID vpc-b7b6d3f01. The instance is connected to a subnet with Subnet ID subnet-fc5458d2 and interface eth0. IAM role is listed as - and Key pair name is keypair2020bdf4da. Platform details show x86\_64-gp2 (ami-09a5b0b7edf08843d). Usage operation and Source/dest. check are both True, and the instance is T2/T3 Unlimited. The instance is running and has 2/2 status checks. The status bar at the bottom indicates the page is from 2008-2020.

Instances | EC2 Manage

Filter by tags and attributes or search by keyword

Name	Instance ID	Instance Type	Availability Zone	Instance State	Status Checks	Alarm Status
	i-0230615234265584f	t2.micro	us-east-1c	running	2/2 checks ...	None

Instance: i-0230615234265584f    Public DNS: ec2-18-233-97-213.compute-1.amazonaws.com

Description	Value	Description	Value
Instance ID	i-0230615234265584f	Public DNS (IPv4)	ec2-18-233-97-213.compute-1.amazonaws.com
Instance state	running	IPv4 Public IP	18.233.97.213
Instance type	t2.micro	IPv6 IPs	-
Finding	You may not have permission to access AWS Compute Optimizer.	Elastic IPs	-
Private DNS	ip-172-31-81-135.ec2.internal	Availability zone	us-east-1c
Private IPs	172.31.81.135	Security groups	launch-wizard-1, view inbound rules, view outbound rules
Secondary private IPs	-	Scheduled events	No scheduled events
VPC ID	vpc-b7b6d3f01	AMI ID	amzn-ami-hvm-2018.03.0.20200318.1-x86_64-gp2 (ami-09a5b0b7edf08843d)
Network interfaces	eth0	Platform details	-
IAM role	-	Usage operation	-
Key pair name	keypair2020bdf4da	Source/dest. check	True
			Disabled

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# Example EC2 Instance Network Configuration

- Public DNS (IPv4): ec2-3-86-208-32.compute-1.amazonaws.com
- Public IPv4: 3.86.208.32
- Private DNS: ip-172-31-87-72.ec2.internal
- Private IP: ip-172-31-87-72.ec2.internal
- VPC ID: vpc-e3247699
- Subnet ID: subnet-449d906a



# Access EC2 VM Instance with SSH client



# Configuring PuTTY SSH Client for Windows

The image shows two side-by-side screenshots of the PuTTY Configuration dialog box.

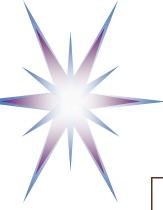
**Left Screenshot (Session Configuration):**

- Category:** Session, Logging, Terminal, Keyboard, Bell, Features, Window, Appearance, Behaviour, Translation, Selection, Colours, Connection, Data, Proxy, Telnet, Rlogin, SSH, Serial.
- Basic options for your PuTTY session:**
  - Host Name (or IP address): ec2-3-86-208-32.compute-1.amazonaws.com
  - Port: 22
  - Connection type: SSH (selected)
- Saved Sessions:** ec2-3-86-208-32.compute-1.amazonaws.com
- Buttons:** Load, Save, Delete.
- Close window on exit:** Only on clean exit (selected).
- Buttons:** About, Help, Open, Cancel.

**Right Screenshot (SSH Authentication Configuration):**

- Category:** Session, Logging, Terminal, Keyboard, Bell, Features, Window, Appearance, Behaviour, Translation, Selection, Colours, Connection, Data, Proxy, Telnet, Rlogin, SSH, Kex, Host keys, Cipher, Auth (selected), GSSAPI, TTY.
- Options controlling SSH authentication:**
  - Display pre-authentication banner (SSH-2 only) (checked)
  - Bypass authentication entirely (SSH-2 only) (unchecked)
- Authentication methods:**
  - Attempt authentication using Pageant (checked)
  - Attempt TIS or CryptoCard auth (SSH-1) (unchecked)
  - Attempt "keyboard-interactive" auth (SSH-2) (checked)
- Authentication parameters:**
  - Allow agent forwarding (unchecked)
  - Allow attempted changes of username in SSH-2 (unchecked)
- Private key file for authentication:** C:\cloud-creds-keys\aws2020educate\key (Browse... button).
- Buttons:** About, Help, Open, Cancel.

- Use PUTTYGEN.EXE to convert key
- Set password, e.g. pswd



# Access VM Instance from Linux

```
demch@DOMA: ~
__|__|__|_
https://aws.amazon.com/amazon-linux-ami/2018.03-release-notes/
4 package(s) needed for security, out of 7 available
Run "sudo yum update" to apply all updates.
[ec2-user@ip-172-31-13-161 ~]$ pwd
/home/ec2-user
[ec2-user@ip-172-31-13-161 ~]$ exit
logout
Connection to ec2-3-125-114-161.eu-central-1.compute.amazonaws.com closed.
demch@DOMA:~$ ssh -i "aws2020bbit02frankfurt.pem" hadoop@ec2-52-59-150-213.eu-central-1.compute.amazonaws.com
ssh: connect to host ec2-52-59-150-213.eu-central-1.compute.amazonaws.com port 22: Resource temporarily unavailable
demch@DOMA:~$ ssh -i "aws2020bbit02frankfurt.pem" ec2-user@ec2-3-125-114-161.eu-central-1.compute.amazonaws.com^C
demch@DOMA:~$ ssh -i "aws2020bbit02frankfurt.pem" ec2-user@ec2-3-125-114-161.eu-central-1.compute.amazonaws.com
Last login: Mon May  4 18:28:59 2020 from g139127.upc-g.chello.nl

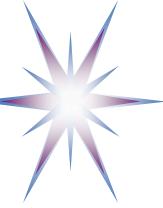
__|__|__|_ ) Amazon Linux AMI
__|__|__|_

https://aws.amazon.com/amazon-linux-ami/2018.03-release-notes/
4 package(s) needed for security, out of 7 available
Run "sudo yum update" to apply all updates.
[ec2-user@ip-172-31-13-161 ~]$ exit
logout
Connection to ec2-3-125-114-161.eu-central-1.compute.amazonaws.com closed.
demch@DOMA:~$ ssh -i "aws2020bbit02frankfurt.pem" hadoop@ec2-52-59-150-213.eu-central-1.compute.amazonaws.com
ssh: connect to host ec2-52-59-150-213.eu-central-1.compute.amazonaws.com port 22: Resource temporarily unavailable
demch@DOMA:~$ chmod 400 aws2020bbit02frankfurt.pem
```

- Your key must not be publicly viewable for SSH to work. Use this command if needed:  
`chmod 400 aws2020bbit02frankfurt.pem`
- To establish a connection to the master node, type the following command.  
`ssh -i ~/aws2020bbit02frankfurt.pem hadoop@ec2-52-59-150-213.eu-central-1.compute.amazonaws.com`



# Configuring VM instance to run Webserver



# Configuring VM instance to run Webserver

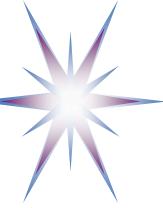
- Connect to ec2 instance with ssh: all commands below are for the VM instance
- Install Apache webserver with PHP (for testing)
  - **\$ sudo yum update -y**
  - **\$ sudo yum install -y httpd.x86\_64 php56 php56-mysqlnd**
- Start the HTTP server
  - **\$ sudo service httpd start**
- Open web browser to check if server is running
  - <http://xxxxxxxxx.compute-1.amazonaws.com> – Use public DNS name for your ec2 instance
  - Note: Check that your security group allows inbound traffic for ports HTTP/80 and HTTPS/453. If no connection available, modify inbound rules: Select security group (default – launch-wizzard-1) > Actions > Edit inbound rules
- Auto start the webserver server with each restart of instance
  - **\$ sudo chkconfig httpd on**
  - **\$ chkconfig --list httpd** -- verify
- Setting permissions for the Apache web server
  - **\$ sudo groupadd www**
  - **\$ sudo usermod -a -G www ec2-user**
  - **\$ sudo chown -R root:www /var/www**
  - **\$ sudo chmod 2775 /var/www**
  - **\$ find /var/www -type d -exec sudo chmod 2775 {} +**
  - **\$ find /var/www -type f -exec sudo chmod 0664 {} +**



# Installing HTTP and PHP packages

```
@ ec2-user@ip-172-31-13-161:~  
Verifying : php56-common-5.6.40-1.143.amzn1.x86_64 1/12  
Verifying : php56-mysqlnd-5.6.40-1.143.amzn1.x86_64 2/12  
Verifying : php56-jsonc-1.3.10-1.20.amzn1.x86_64 3/12  
Verifying : php56-process-5.6.40-1.143.amzn1.x86_64 4/12  
Verifying : php56-cli-5.6.40-1.143.amzn1.x86_64 5/12  
Verifying : apr-1.5.2-5.13.amzn1.x86_64 6/12  
Verifying : php56-pdo-5.6.40-1.143.amzn1.x86_64 7/12  
Verifying : apr-util-ldap-1.5.4-6.18.amzn1.x86_64 8/12  
Verifying : httpd-tools-2.2.34-1.16.amzn1.x86_64 9/12  
Verifying : php56-xml-5.6.40-1.143.amzn1.x86_64 10/12  
Verifying : httpd-2.2.34-1.16.amzn1.x86_64 11/12  
Verifying : apr-util-1.5.4-6.18.amzn1.x86_64 12/12  
  
Installed:  
httpd.x86_64 0:2.2.34-1.16.amzn1          php56-mysqlnd.x86_64 0:5.6.40-1.143.amzn1  
  
Dependency Installed:  
apr.x86_64 0:1.5.2-5.13.amzn1           apr-util.x86_64 0:1.5.4-6.18.amzn1  
apr-util-ldap.x86_64 0:1.5.4-6.18.amzn1   httpd-tools.x86_64 0:2.2.34-1.16.amzn1  
php56-cli.x86_64 0:5.6.40-1.143.amzn1    php56-common.x86_64 0:5.6.40-1.143.amzn1  
php56-jsonc.x86_64 0:1.3.10-1.20.amzn1    php56-pdo.x86_64 0:5.6.40-1.143.amzn1  
php56-process.x86_64 0:5.6.40-1.143.amzn1  php56-xml.x86_64 0:5.6.40-1.143.amzn1  
  
Skipped (dependency problems):  
httpd24.x86_64 0:2.4.41-1.88.amzn1       httpd24-tools.x86_64 0:2.4.41-1.88.amzn1  
php56.x86_64 0:5.6.40-1.143.amzn1  
  
Complete!  
[ec2-user@ip-172-31-13-161 ~]$ sudo yum install -y httpd.x86_64 php56 php56-mysqlnd --skip-broken
```

- sudo yum install -y httpd24 php72 mysql57-server php72-mysqlnd



# Uploading Webserver content

The screenshot shows a web browser window with the URL <http://ec2-3-125-114-161.eu-central-1.compute.amazonaws.com>. The page content is as follows:

**The Pulpit Rock (Preikestolen)**

[The Drive](#)  
[The Walk](#)  
[The Return](#)  
[The End](#)

**The Walk**

The walk to the Pulpit Rock will take you approximately two hours, give or take an hour depending on the weather conditions and your physical shape.

**What?**

The Pulpit Rock (Pfriekestolen in Norwegian) is a part of a mountain that looks like a pulpit.

**Where?**

The Pulpit Rock is in Norway.

**Price?**

The Walk is free!

A large image of people standing on the edge of the Pulpit Rock is centered below the main content area.

- Placing your test content in `/var/www/html/`
- Use SCP or SFTP configured with access key similar to PuTTY
-



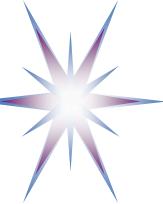
# Commands for controlling services

- Two officially adopted methods for controlling services:
- `systemctl`: CentOS, Ubuntu, Redhat, Fedora
  - `sudo systemctl stop httpd`
  - `sudo systemctl start httpd`
  - `sudo systemctl restart httpd`
- `service`: Debian
  - `sudo service httpd start`
  - `sudo service httpd stop`
  - `sudo service httpd restart`



# Working with S3 Storage

- Create Bucket
- Configure security
- Add monitoring

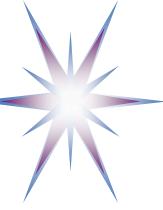


# S3 Storage: Create bucket & Select Region

The screenshot shows the AWS S3 Management Console interface. In the top navigation bar, the URL is https://s3.console.aws.amazon.com/s3/bucket/create?region=us-east-1. The main area is titled "Amazon S3" and shows a form for creating a new bucket. The "Bucket name" field contains "mybucket4bdit". Below it, a note states: "Bucket name must be unique and must not contain spaces or uppercase letters. See rules for bucket naming." The "Region" dropdown is open, showing various AWS regions. The "US East (N. Virginia) us-east-1" region is selected. A search bar is present above the region list. A tooltip on the right side of the screen provides information about setting policies and access points. At the bottom, a warning message cautions against turning off block all public access.

Feedback English (US)

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# Configure S3 Bucket Properties and Management aspects (monitoring and metrics)

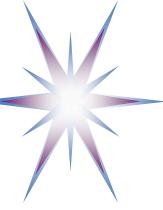
The screenshot displays two side-by-side views of the AWS S3 Management Console for a bucket named "mybucket4bdit".

**Left Panel (Bucket Properties):**

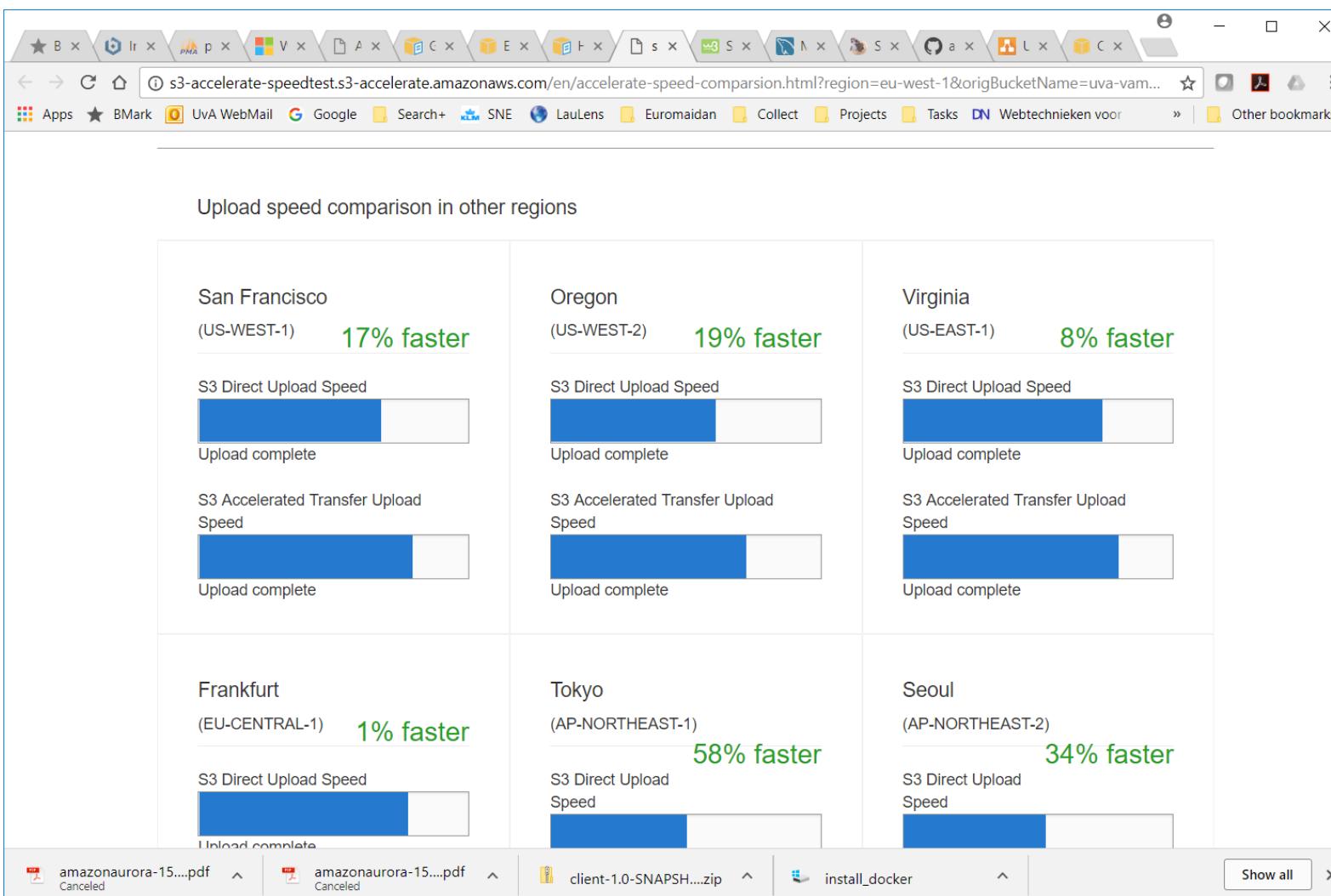
- Versioning:** Keep multiple versions of an object in the same bucket. Status: Disabled.
- Server access logging:** Set up access log records that provide details about access requests. Status: Disabled.
- Object-level logging:** Record object-level API activity using the CloudTrail data events feature (additional cost). Status: Disabled.
- Default encryption:** Automatically encrypt objects when stored in Amazon S3. Status: Disabled.

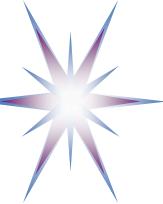
**Right Panel (Bucket Management):**

- Management Tab:** Shows tabs for Overview, Properties, Permissions, Management (selected), and Access points.
- Metrics Sub-tab:** Shows tabs for Lifecycle, Replication, Analytics, Metrics (selected), and Inventory.
- Metrics Details:** A modal window provides information about metric retrieval delays and lists available metrics:
  - Storage metrics:** 2 free metrics.
  - Request metrics:** 10 paid metrics.
  - Data transfer metrics:** 6 paid metrics.
- Metrics Summary:** Shows that no metrics are currently available for Data transfer.



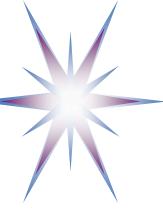
# S3: Upload acceleration (example)





# Adding Monitoring to EC2 and S3

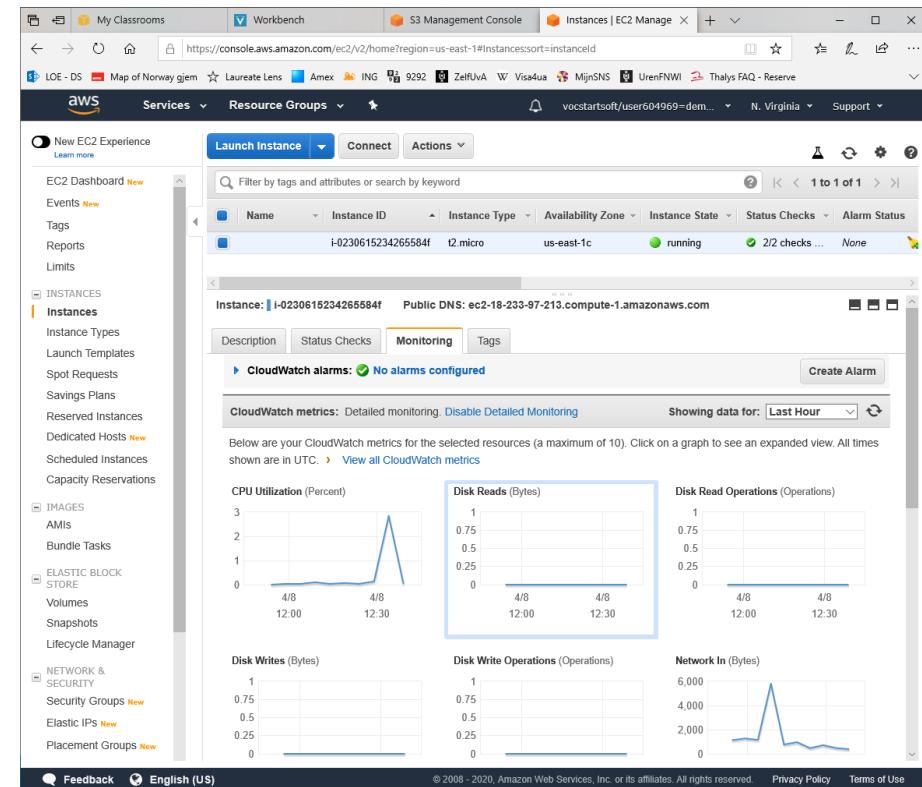
- For EC2: Enable detailed monitoring for EC2 instance during deployment
- For S3: configure monitoring after S3 bucket is created



# EC2 instances and Monitoring - Prepare

- Create/download Key Pair
  - aws2020mon: fingerprint c9:98:3b:a9:a4:ed:3e:da:94:51:8a:c0:80:0b:4b:10:5e:e4:7e:bf
- Create Instance: Wordpress by Bitnami
  - vpc-4fcc132a – subnet-85003ead | us-east-1a

The screenshot shows the AWS EC2 Instances dashboard. On the left, there's a sidebar with links like EC2 Dashboard, Events, Tags, Reports, Limits, Instances, Launch Templates, Spot Requests, Reserved Instances, Dedicated Hosts, Scheduled Instances, Capacity Reservations, Images, AMIs, Bundle Tasks, and Elastic Block Store. The main area has tabs for Launch Instance, Connect, and Actions. Under Actions, a dropdown menu is open with options: Connect, Get Windows Password, Create Template From Instance, Launch More Like This, Instance State, Instance Settings, Image, Networking, ClassicLink, CloudWatch Monitoring (which is highlighted), CloudWatch Metrics, Enable Detailed Monitoring, Disable Detailed Monitoring, and Add/Edit Alarms. Below this, there's a section for CloudWatch metrics with two graphs: CPU Utilization (Percent) and Disk Reads (Bytes). At the bottom, there are links for Feedback, English (US), Privacy Policy, Terms of Use, and a file browser showing 'aws2019mon.pem'.





# EC2 Monitoring Dashboard

The screenshot shows the AWS CloudWatch Metrics dashboard for the EC2 service. The left sidebar lists navigation options like Dashboards, Alarms, and Metrics. The main area displays six metrics in a grid:

- Network Out Average**: Shows Bytes over time. Data points: 75.0, 7.68k, 15.2k.
- Network Packets In Average**: Shows Count over time. Data points: 1.62, 1.08k, 2.16k.
- Network Packets Out Average**: Shows Count over time. Data points: 0.5, 52.7, 104.
- Status Check Failed Sum**: Shows Count over time. Data point: 1.00.
- Status Check Failed Instance S...**: Shows Count over time. Data point: 0.5.
- Status Check Failed System Sum**: Shows Count over time. Data point: 1.00.

The top navigation bar includes links for Services, Resource Groups, and Support, along with user information for Yuri Demchenko and N. Virginia.

- Configure EC2 metrics
    - Many
  - Create dashboard

The screenshot shows the AWS CloudWatch Metrics interface. On the left, there's a detailed monitoring view for an EC2 instance, including an availability zone (us-east-1a), instance state (running), and status checks (2/2 passed). A 'Create Alarm' button is visible. Below this is a 'Disk Read Operations' chart showing data over the last 3 hours. The main area features a metric graph titled 'Add metric graph' with a single line series. The x-axis represents time from 11:15 to 12:45. The y-axis represents metric values. The line shows a flat baseline around 1.0 until 12:00, followed by a sharp peak reaching approximately 2.5 at 12:15, before returning to baseline. The legend identifies the series as 'ReadBytes'. To the right of the graph is a table of metrics:

	Statistic	Period	Y Axis	Actions
DiskReadBytes	Average	5 Minutes	< > <input type="button" value="Edit"/> <input type="button" value="Delete"/>	
DiskWriteBytes	Average	5 Minutes	< > <input type="button" value="Edit"/> <input type="button" value="Delete"/>	
DiskReadOps	Average	5 Minutes	< > <input type="button" value="Edit"/> <input type="button" value="Delete"/>	
DiskWriteOps	Average	5 Minutes	< > <input type="button" value="Edit"/> <input type="button" value="Delete"/>	



# S3 Bucket properties and monitoring

## Advance setting

- Name arn:aws:s3:::s3retentionsample-s3bucket-198nq9ci8nwle
- s3retentionsample-s3bucket-198nq9ci8nwle

## Settings: Metadata

Object lock

Tags

Key	Value
aws:cloudformation:stack-id	arn:aws:cloudformation:us-east-1:123456789012:stack/S3RetentionSample
aws:cloudformation:stack-name	S3RetentionSample

## Permissions

- Tagging: instances to track and clean
- Permissions/access control
- Management
  - Lifecycle rules e.g. move to Gleischer
  - Transition – expiration
- Analytics
- Metrics
  - Storage metrics (Free)
  - Request metrics (paid)
  - Data transfer (paid)
- Inventory

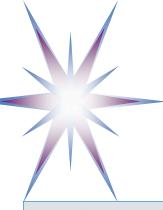
## Metrics

Metrics

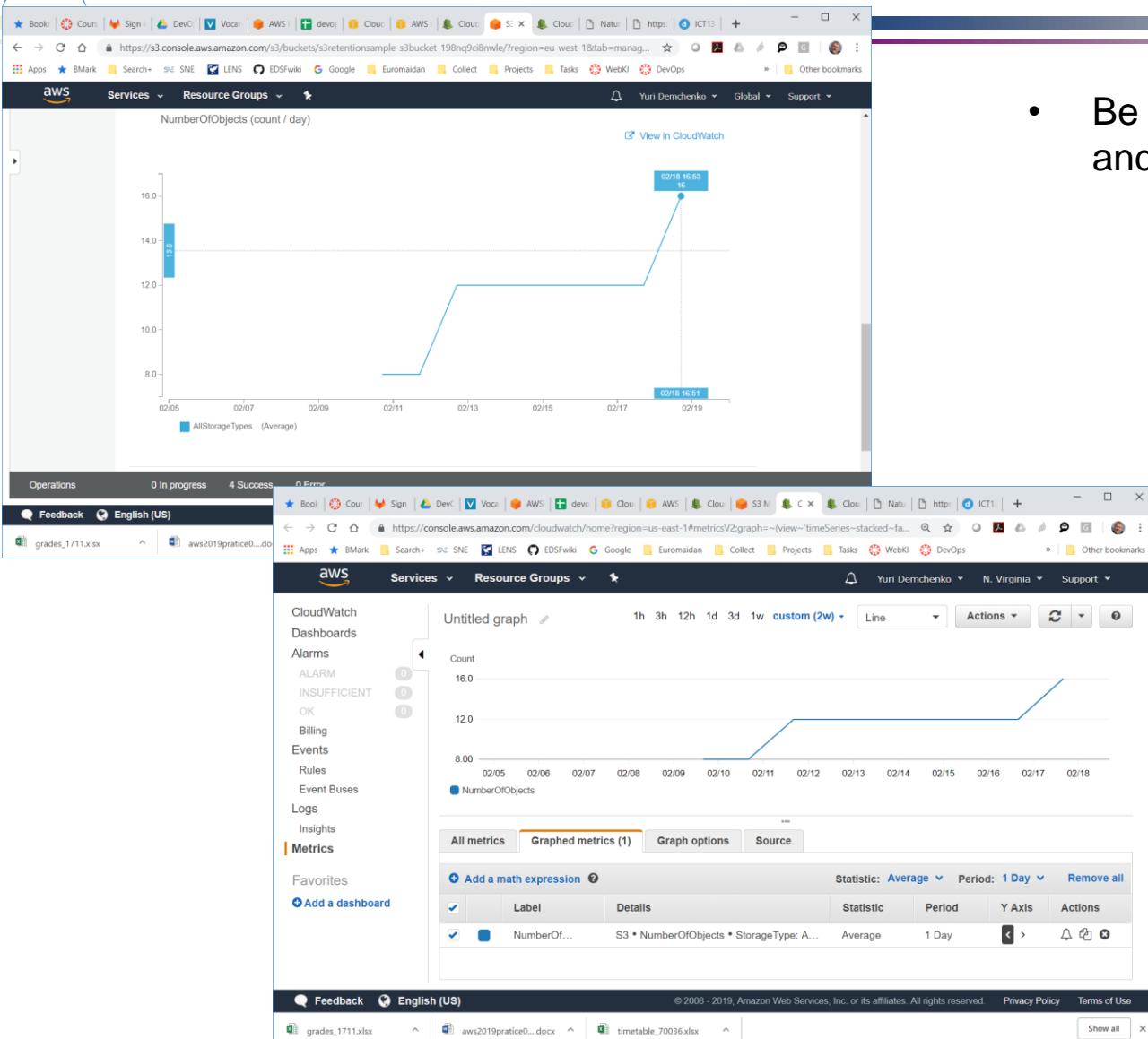
Storage Requests Data transfer 1h 3h 12h

Inventory

## Inventory



# S3 metrics and Dashboard metrics



- Be aware of delay in collecting and displaying metrics



# Amazon Lambda Serverless Computing



# Starting with AWS Lambda (for Serverless Computing)

The screenshot shows the 'Create function' wizard in the AWS Lambda console. The user has selected the 'Author from scratch' option. The 'Basic information' section is filled out with a function name 'myTestFunction01' and a runtime 'Node.js 12.x'. The 'Permissions' section is expanded, showing the 'Choose or create an execution role' step. At the bottom right, there are 'Cancel' and 'Create function' buttons.

Choose one of the following options to create your function.

- Author from scratch**  Start with a simple Hello World example.
- Use a blueprint**  Build a Lambda application from sample code and configuration presets for common use cases.
- Browse serverless app repository**  Deploy a sample Lambda application from the AWS Serverless Application Repository.

**Basic information**

**Function name**  
Enter a name that describes the purpose of your function.

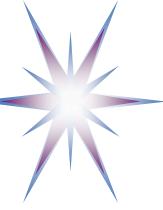
Use only letters, numbers, hyphens, or underscores with no spaces.

**Runtime** [Info](#)  
Choose the language to use to write your function.

**Permissions** [Info](#)  
Lambda will create an execution role with permission to upload logs to Amazon CloudWatch Logs. You can configure and modify permissions further when you add triggers.

▶ Choose or create an execution role

**Create function**



# Lambda FirstLabHello (1)

The screenshot shows the AWS Lambda console interface. The left sidebar displays the function name "HelloBDAworld". The main area shows the "index.js" file content:

```
3  console.log('Loading function...');  
4  
5  exports.handler = (event, context, callback) => {  
6    //console.log('Received event:', JSON.stringify(event, null, 2));  
7    console.log('value1 =', event.key1);  
8    console.log('value2 =', event.key2);  
9    console.log('value3 =', event.key3);  
10   callback(null, event.key1); // Echo back the first key value  
11   //callback('Something went wrong');  
12 };  
13
```

The "Actions" dropdown is set to "FirstLabHello". Below the code editor is the "Execution Result" panel, which shows the following details:

- Status: Succeeded
- Max Memory Used: 20 MB
- Time: 31.95 ms
- Response: "value1"
- Request ID: "e2424e4f-ee2b-11e7-bd70-d9c58984d0e7"
- Function Logs:  
START RequestId: e2424e4f-ee2b-11e7-bd70-d9c58984d0e7 Version: \$LATEST  
2017-12-31T13:09:50.551Z e2424e4f-ee2b-11e7-bd70-d9c58984d0e7 value1 = value1  
2017-12-31T13:09:50.551Z e2424e4f-ee2b-11e7-bd70-d9c58984d0e7 value2 = value2  
2017-12-31T13:09:50.551Z e2424e4f-ee2b-11e7-bd70-d9c58984d0e7 value3 = value3  
END RequestId: e2424e4f-ee2b-11e7-bd70-d9c58984d0e7  
REPORT RequestId: e2424e4f-ee2b-11e7-bd70-d9c58984d0e7 Duration: 31.95 ms Billed Duration: 100 ms Memory Size: 128 MB Max Me

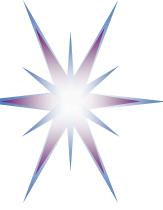


# Lambda FirstLabHello (2)

The screenshot shows the AWS CloudWatch Log Groups interface. The left sidebar is collapsed, and the main area displays log entries for the /aws/lambda/HelloBDWorld function. The log entries are as follows:

Time (UTC +00:00)	Message
2017-12-31	No older events found at the moment. Retry.
12:57:19	2017-12-31T12:57:19.049Z 222ef87e-ee2a-11e7-812b-dda311477d41 Loading function
12:57:19	START RequestId: 222ef87e-ee2a-11e7-812b-dda311477d41 Version: \$LATEST
12:57:19	2017-12-31T12:57:19.053Z 222ef87e-ee2a-11e7-812b-dda311477d41 value1 = value1
12:57:19	2017-12-31T12:57:19.070Z 222ef87e-ee2a-11e7-812b-dda311477d41 value2 = value2
12:57:19	2017-12-31T12:57:19.070Z 222ef87e-ee2a-11e7-812b-dda311477d41 value3 = value3
12:57:19	END RequestId: 222ef87e-ee2a-11e7-812b-dda311477d41
12:57:19	REPORT RequestId: 222ef87e-ee2a-11e7-812b-dda311477d41 Duration: 19.91 ms Billed Duration: 100 ms Memory Size: 128 MB Max Memo
13:09:50	START RequestId: e2424e4f-ee2b-11e7-bd70-d9c58984d0e7 Version: \$LATEST
13:09:50	2017-12-31T13:09:50.551Z e2424e4f-ee2b-11e7-bd70-d9c58984d0e7 value1 = value1
13:09:50	2017-12-31T13:09:50.551Z e2424e4f-ee2b-11e7-bd70-d9c58984d0e7 value2 = value2
13:09:50	2017-12-31T13:09:50.551Z e2424e4f-ee2b-11e7-bd70-d9c58984d0e7 value3 = value3
13:09:50	END RequestId: e2424e4f-ee2b-11e7-bd70-d9c58984d0e7
13:09:50	REPORT RequestId: e2424e4f-ee2b-11e7-bd70-d9c58984d0e7 Duration: 31.95 ms Billed Duration: 100 ms Memory Size: 128 MB Max Memo

At the bottom, it says "No newer events found at the moment. Retry."



# Lambda FirstLabHello (3) – CloudWatch Monitoring

Secure | https://eu-west-1.console.aws.amazon.com/lambda/home?region=eu-west-1#/functions>HelloBDWorld?tab=monitoring

aws Services Resource Groups Yuri Demchenko Ireland Support

## HelloBDWorld

Qualifiers Actions FirstLabHello Test Save

Configuration Monitoring

CloudWatch metrics at a glance (aggregated per hour)

View traces in X-Ray

Last 24 hours ▾

Invocation count

Jump to Metrics Jump to Logs

Count: 1

Max Milliseconds Avg Milliseconds Min Milliseconds

Last 24 hours ▾

Invocation duration

Jump to Metrics Jump to Logs

Feedback English (US)

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Show all

amazonaurora-15....pdf Canceled

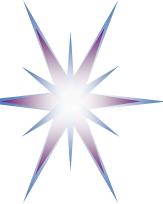
amazonaurora-15....pdf Canceled

client-1.0-SNAPSHOT.zip

install\_docker



# Automating AWS resources deployment with CloudFormation



# Using CloudFormation for Resource Deployment

- CloudFormation is the internal cloud resources configuration and automated provisioning tool
- CloudFormation template describes configuration of a single or multiple resources
- CloudFormation template is re-usable but not composable



# Creating S3 bucket via CF template

<https://docs.aws.amazon.com/AWSCloudFormation/latest/UserGuide/sample-templates-services-us-east-1.html>

The screenshot shows the AWS CloudFormation Designer interface. On the left, there's a sidebar with a list of 'Name' and 'Description' for various sample templates. The descriptions include details like 'Creates an Amazon RDS database instance with provisioned IOPS.', 'Creates an Amazon RDS database instance with a read replica.', 'Creates an Amazon RDS database instance with a deletion policy that specifies Amazon RDS to take a snapshot of the database before deleting it.', and 'Creates an Amazon RDS database'. Each entry has 'View' and 'View in Designer' buttons, and a 'Launch stack' button.

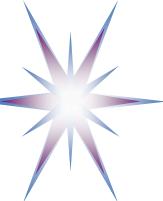
The screenshot shows the AWS CloudFormation Designer canvas. A red box highlights a 'Bucket' icon, which is labeled 'S3B6SSQ'. The canvas also features a notepad icon and a plus sign icon for adding new resources.

The screenshot shows the AWS CloudFormation template editor. The template file 'template1' is open, showing JSON code for creating an S3 bucket named 'S3B6SSQ'. The code includes the 'Type' field set to 'AWS::S3::Bucket' and the 'Properties' field set to '{}'. The status bar at the bottom right indicates 'Successfully converted the template to JSON.'

```
{  
    "AWSTemplateFormatVersion" : "2010-09-09",  
  
    "Description" : "AWS CloudFormation Sample Template  
S3_Website_Bucket_With_Retain_On_Delete: Sample template  
showing how to create a publicly accessible S3 bucket  
configured for website access with a deletion policy of  
retain on delete. **WARNING** This template creates an S3  
bucket that will NOT be deleted when the stack is deleted.  
You will be billed for the AWS resources used if you create  
a stack from this template.",  
  
    "Resources" : {  
        "S3Bucket" : {  
            "Type" : "AWS::S3::Bucket",  
            "Properties" : {  
                "AccessControl" : "PublicRead",  
                "WebsiteConfiguration" : {  
                    "IndexDocument" : "index.html",  
                    "ErrorDocument" : "error.html"  
                }  
            },  
            "DeletionPolicy" : "Retain"  
        }  
    },  
  
    "Outputs" : {  
        "WebsiteURL" : {  
            "Value" : { "Fn::GetAtt" : [ "S3Bucket", "WebsiteURL" ] }  
        },  
        "Description" : "URL for website hosted on S3"  
    },  
    "S3BucketSecureURL" : {  
        "Value" : { "Fn::Join" : [ "", [ "https://", {  
            "Fn::GetAtt" : [ "S3Bucket", "DomainName" ] } ] ] }  
    },  
    "Description" : "Name of S3 bucket to hold website  
content"  
}  
}
```

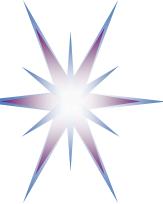
Create -> Upload Files -> Default properties for files

gging, Auditing Tools



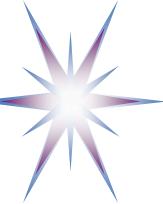
# Closer look at S3 bucket template

```
{  
    "AWSTemplateFormatVersion" : "2010-09-09",  
  
    "Description" : "AWS CloudFormation Sample Template S3_Website_Bucket_With_Retain_On_Delete: Sample template showing how to create a publicly accessible S3 bucket configured for website access with a deletion policy of retain on delete. **WARNING** This template creates an S3 bucket that will NOT be deleted when the stack is deleted. You will be billed for the AWS resources used if you create a stack from this template.",  
  
    "Resources" : {  
        "S3Bucket" : {  
            "Type" : "AWS::S3::Bucket",  
            "Properties" : {  
                "AccessControl" : "PublicRead",  
                "WebsiteConfiguration" : {  
                    "IndexDocument" : "index.html",  
                    "ErrorDocument" : "error.html"  
                }  
            },  
            "DeletionPolicy" : "Retain"  
        }  
    },  
  
    "Outputs" : {  
        "WebsiteURL" : {  
            "Value" : { "Fn::GetAtt" : [ "S3Bucket", "WebsiteURL" ] },  
            "Description" : "URL for website hosted on S3"  
        },  
        "S3BucketSecureURL" : {  
            "Value" : { "Fn::Join" : [ "", [ "https://", { "Fn::GetAtt" : [ "S3Bucket", "DomainName" ] } ] ] },  
            "Description" : "Name of S3 bucket to hold website content"  
        }  
    }  
}
```



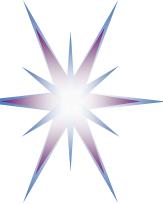
# Setting up your Cloud Development Environment

- Python and PIP
- Windows PowerShell
- Windows Extension for Linux
- AWS CLI
  - On Windows and PowerShell
  - On Linux



# Python and PIP

- Ubuntu 18.04 ships with Python 3, as the default Python installation.
- Complete the following steps to install pip (pip3) for Python 3:
  - Start by updating the package list using the following command:  
`sudo apt update`
  - Use the following command to install pip for Python 3:  
`sudo apt install python3-pip`  
The command above will also install all the dependencies required for building Python modules.
- Once the installation is complete, verify the installation by checking the pip version:  
`pip3 --version`



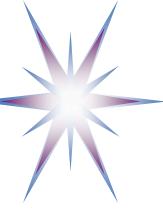
# Installing Python 3.8 on Linux/Debian/Ubuntu

- **How to Install Python 3.8 on Ubuntu 18.04**
- <https://linuxize.com/post/how-to-install-python-3-8-on-ubuntu-18-04/>
- Check
  - \$ python3.8 –version
- **Installing pip for Python 3**
  - sudo apt install python3-pip
- Check
  - Pip3 –version
  - pip 9.0.1 from /usr/lib/python3/dist-packages (python 3.6)



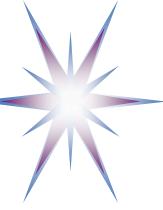
# Windows PowerShell and WSL

- <https://docs.microsoft.com/en-us/windows/wsl/faq>
- Available in Microsoft Store
- Install on Windows 10: From PowerShell
  - Enable-WindowsOptionalFeature -Online -FeatureName Microsoft-Windows-Subsystem-Linux
- Run WSL
  - **Set up a new Linux user account**
- Update and upgrade packages
  - sudo apt update && sudo apt upgrade
- 
- Access local machine's filesystem from within the Linux Bash shell
  - Local drives mounted under the /mnt folder, e.g. C: drive is mounted under /mnt/c:



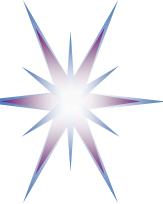
# AWS CLI

- Download the AWS CLI MSI installer for Windows (64-bit) at <https://awscli.amazonaws.com/AWSCLIV2.msi>
- To confirm version
  - > aws –version
  - > aws-cli/2.0.6 Python/3.7.4 Windows/10 botocore/2.0.0
- Usage:
  - aws [options] <command> <subcommand> [<subcommand> ...] [parameters]
- To see help text, you can run:
  - aws help
  - aws <command> help
  - aws <command> <subcommand> help



# AWS CLI on Linux

- Prerequisite: Python 3+ and python-pip
- From Windows Extension for Linux Debian
  - sudo apt-get install python-pip python-dev build-essential
- **\$ sudo apt install awscli**
  - Option: sudo pip install awscli
  - Other: sudo pip install --upgrade --user awscli
- Check
  - aws –version
  - aws-cli/1.16.113 Python/3.7.3 Linux/4.4.0-18362-Microsoft botocore/1.12.103



# Copy key to working directory

- To copy a file from your current directory into another directory called /tmp/, enter:

```
$ cp filename /tmp
```

```
$ ls /tmp/filename
```

```
$ cd /tmp
```

```
$ ls
```

```
$ rm filename
```