NYU | TANDON SCHOOL OF ENGINEERING

FRE6883
Financial Computation

NYU | TANDON SCHOOL OF ENGINEERING

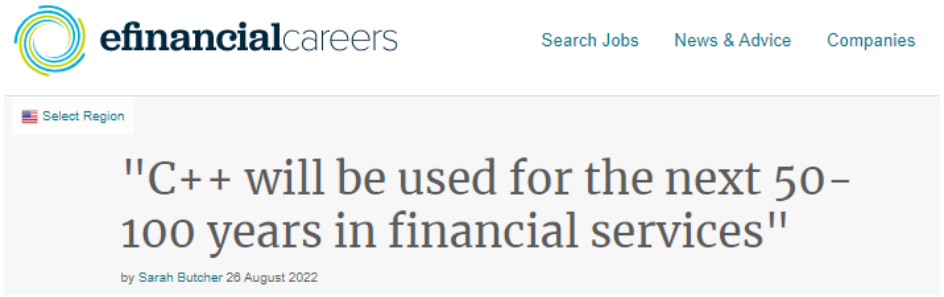
Topic 1
Set up AWS Cloud 9 for C++ Development

What are prerequisites?

- Have knowledge about derivates and quantitative methods of option pricing.
- Be aware of elementary programming concepts such as variable declaration and flow control structures such as sequential, looping and conditional statements in general.
- Knowledge in another programming language such as Python is helpful. But it is important not try to fit C/C++ into the language you already know.

Why C++?

- C++ is an industry standard because of its flexibility and performance. It has been the selected language for backend engine in many software applications. C++ is a powerful modern object-oriented language.
- Many 3rd party libraries have been created to integrate market data and conduct complex numerical calculations in C++ applications with high efficiency.
- C++ has been used in creating financial applications which need to process significant amount of historical data and complete complicated computation in real-time.



The Difficulty of Learning C++

- C++ may not be an ideal language for beginners. It provides far more flexibility to programmers often more than required and could be confusing.
- It is very easy to make mistakes and have bugs especially when pointers are used.
- The object-oriented programming concept is not easy to grasp.
- The good news is that once you know C++, learning other programming languages become easier.

Why AWS Cloud9 for C++ Development?

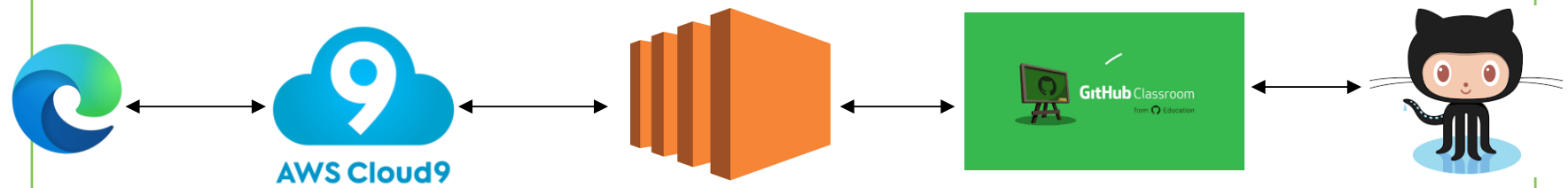
- C++ is very “close to the hardware”, which means that the ways of building financial applications could be different in different computer systems.
- The development environments for C++ applications are different in Windows, MAC, and Linux, which increases the difficulty for students to learn C++.
- Using GNU Compiler Collection (G++) in Linux virtual environment has become standard software development environment for financial industry.
- AWS Cloud9 is a G++ development environment with Linux EC2 instance, and it is almost free.

What is AWS Cloud 9?

- AWS Cloud9 is an integrated software development environment (IDE) and could be easily access through a Web browser.
- For using the AWS Cloud9 IDE, running in a web browser on our local computer, to interact with our AWS Cloud9 environment, which is connected to an Amazon EC2 instance. All the source codes will be committed to GitHub remote repository.

https://docs.aws.amazon.com/cloud9/latest/user-guide/welcome.html

Our C++ Programming Environment



Web Browser | AWS Cloud9 Environment | AWS EC2 Instance | GitHub Classroom | GitHub Repository

Benefits of Using AWS Cloun9

- AWS Cloud9 offers an industry-level development environment to edit, build and run C++ programs and applications. The free-tier is sufficient for our learning purpose.
- Using the AWS Cloud9 IDE, we can:
  - Store our project's files locally on the instance or server.
  - Sync with a remote code repository – We use GitHub as the remote repository.
- Work with a combination of local and cloned files in the environment.
- By storing the environment in the cloud, our projects no longer need to be tied to a single computer or IDE setup, all the students will have a standardized development environment, and make teaching more efficient.

GitHub Classroom

- GitHub Classroom automates repository creation and access control. It offer an integrated platform for distributing starter code from GitHub and managing homework assignments.

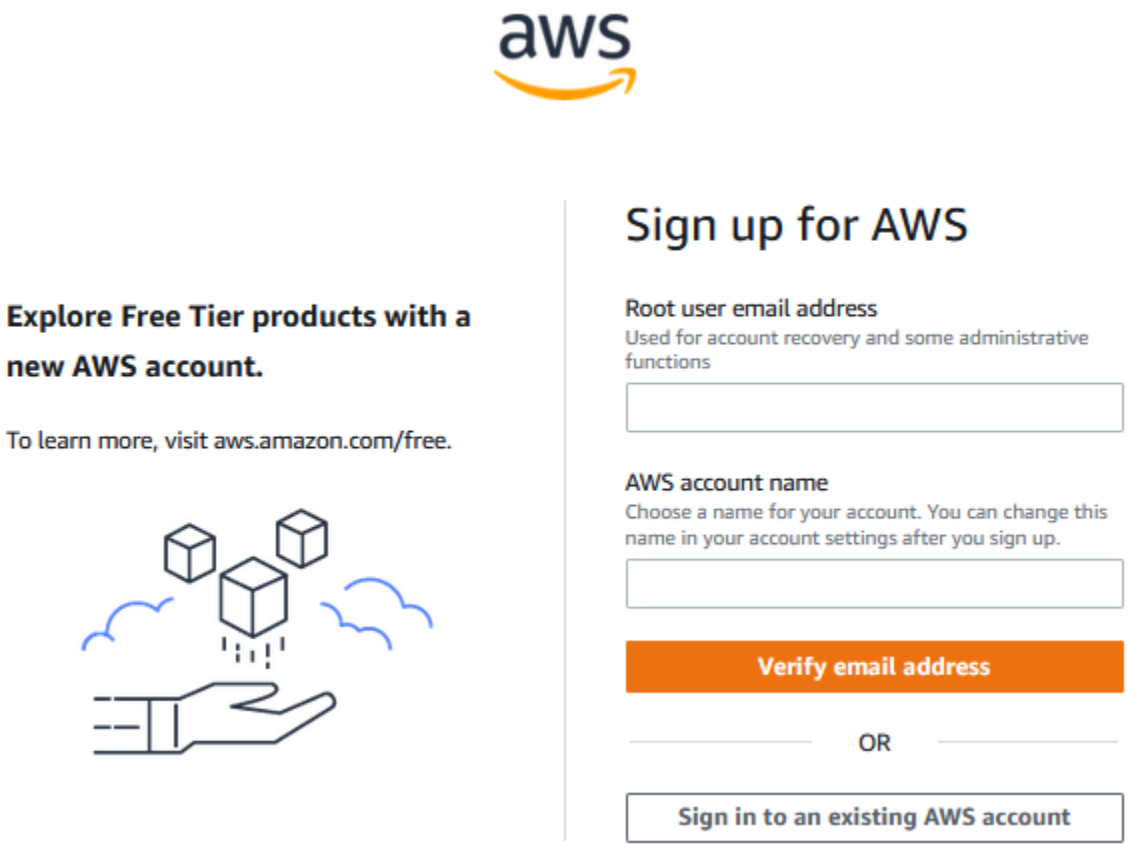
GitHub Repository

- GitHub is a website providing cloud-based service store and manage source codes for software applications, as well as track and control changes to the source codes.
  - The lecture source codes, and student's assignments are organized in projects.
  - A GitHub Repository contains all the project's files and each file's revision history.
  - GitHub provides free service for personal usage as well as educational organization.
  - GitHub is one of the world's largest community of software developers, and many employers use GitHub.
  - It will be a big plus for students in finance if the students could show potential employers their GitHub repositories with the history of completed projects.
- https://docs.github.com/en/repositories/creating-and-managing-repositories/about-repositories

AWS Cloud 9 Setup

- Create AWS Account
  - **Personal – for your own project**
  - **Basic support – Free**
- Add IAM User to your account
- Sign in as IAM User
- Create AWS Cloud 9 IDE Environment
- Create GitHub account and Join FRE6883 GitHub classroom for homework assignments
- Clone the Homework Assignment 1 to Cloud9 Env

Create AWS Account, https://aws.amazon.com/



Sign up for AWS

Select a support plan

Choose a support plan for your business or personal account. Compare plans and pricing examples. You can change your plan anytime in the AWS Management Console.

Basic support - Free

- Recommended for new users just getting started with AWS
- 24x7 self-service access to AWS resources
- For account and billing issues only
- Access to Personal Health Dashboard & Trusted Advisor

Developer support - From $29/month

- Recommended for developers experimenting with AWS
- Email access to AWS Support during business hours
- 12 (business)-hour response times

Business support - From $100/month

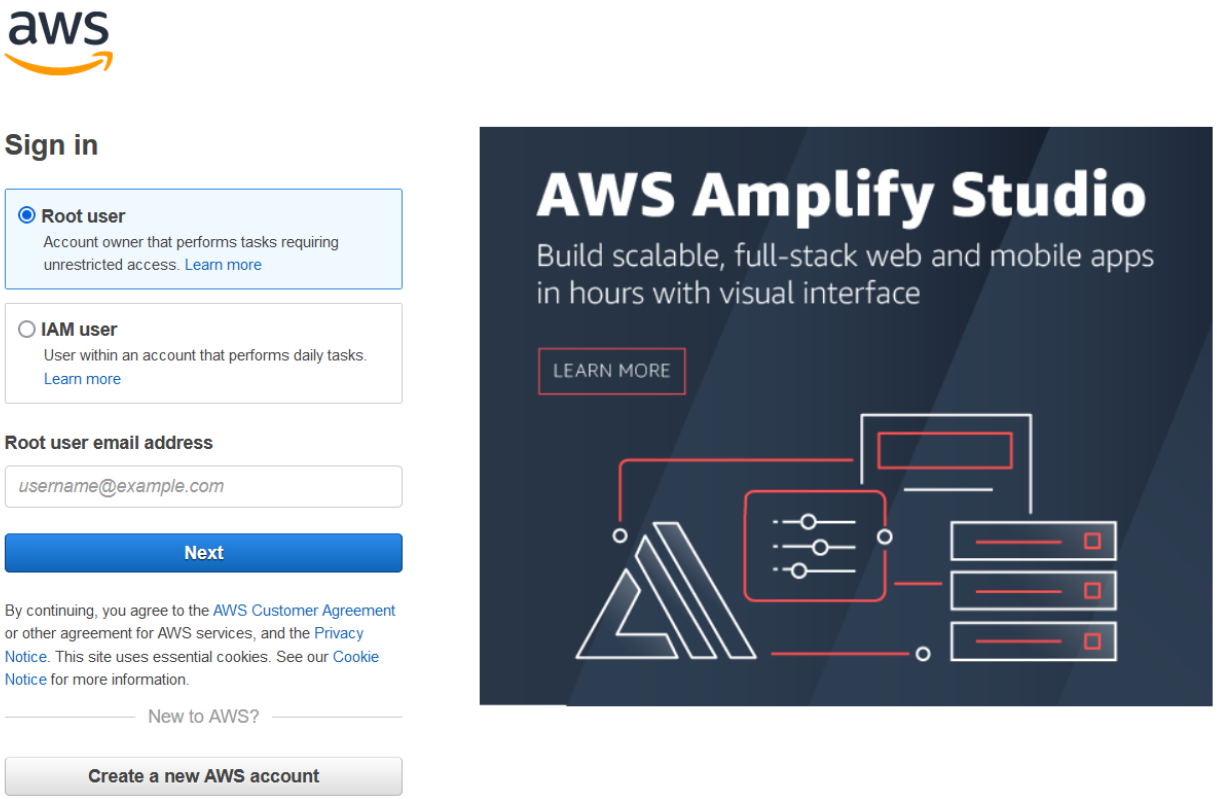
- Recommended for running production workloads on AWS
- 24x7 tech support via email, phone, and chat
- 1-hour response times
- Full set of Trusted Advisor best-practice recommendations

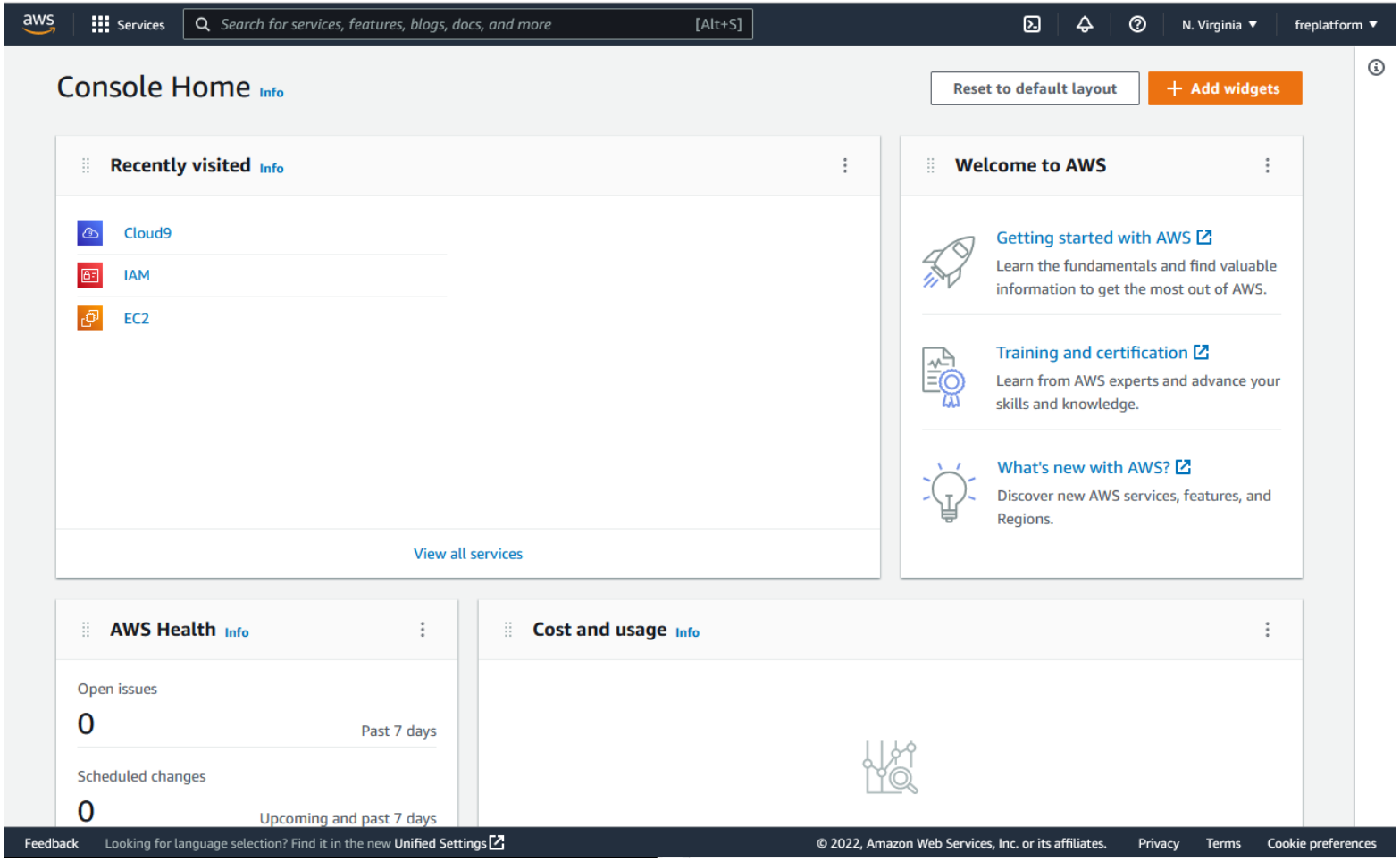
Need Enterprise level support?

From $15,000 a month you will receive 15-minute response times and concierge-style experience with an assigned Technical Account Manager. Learn more

Complete sign up

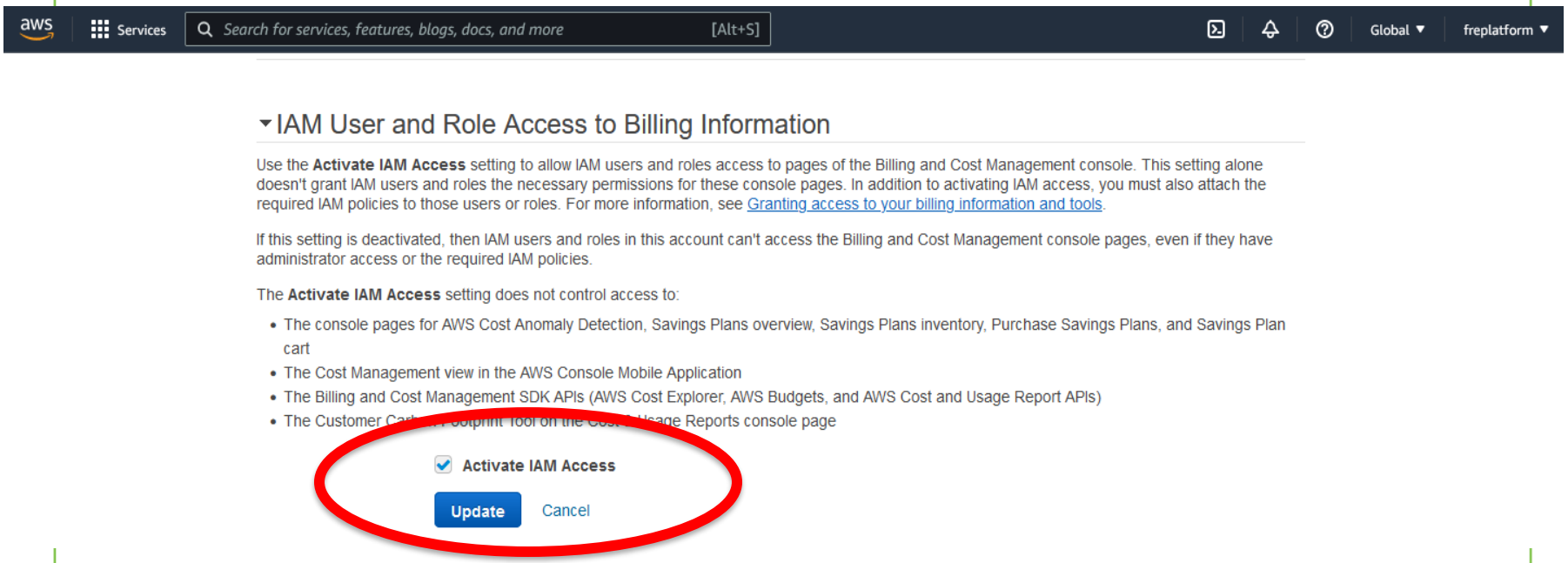
Sign in as Root User for AWS Account Console




aws
Services
Search for services, features, blogs, docs, and more
[Alt+S]
N. Virginia
freplatform
Console Home Info
Reset to default layout
+ Add widgets
Recently visited Info
Cloud9
IAM
EC2
View all services
Welcome to AWS
Getting started with AWS
Learn the fundamentals and find valuable information to get the most out of AWS.
Training and certification
Learn from AWS experts and advance your skills and knowledge.
What's new with AWS?
Discover new AWS services, features, and Regions.
AWS Health Info
Open issues
0
Past 7 days
Scheduled changes
0
Upcoming and past 7 days
Cost and usage Info
Feedback
Looking for language selection? Find it in the new Unified Settings
© 2022, Amazon Web Services, Inc. or its affiliates.
Privacy
Terms
Cookie preferences

Create admin IAM user and user group (1)

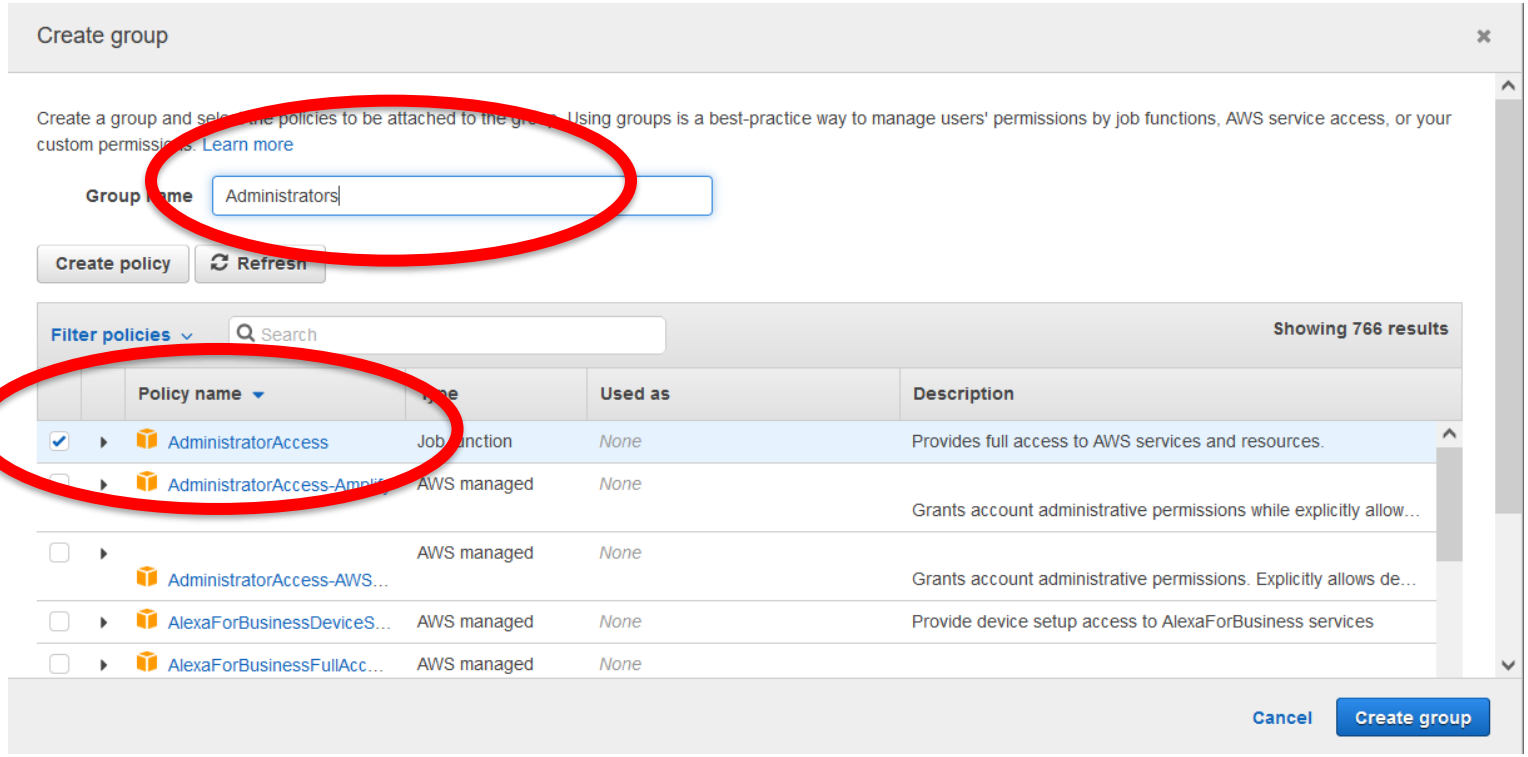
- **Enable access to billing data for the IAM admin user we are going to create.**



Click on My Account on the Right-hand top. Click on Edit under “IAM User and Role Access to Billing Information” and check “Activate IAM Access” and click on Update.

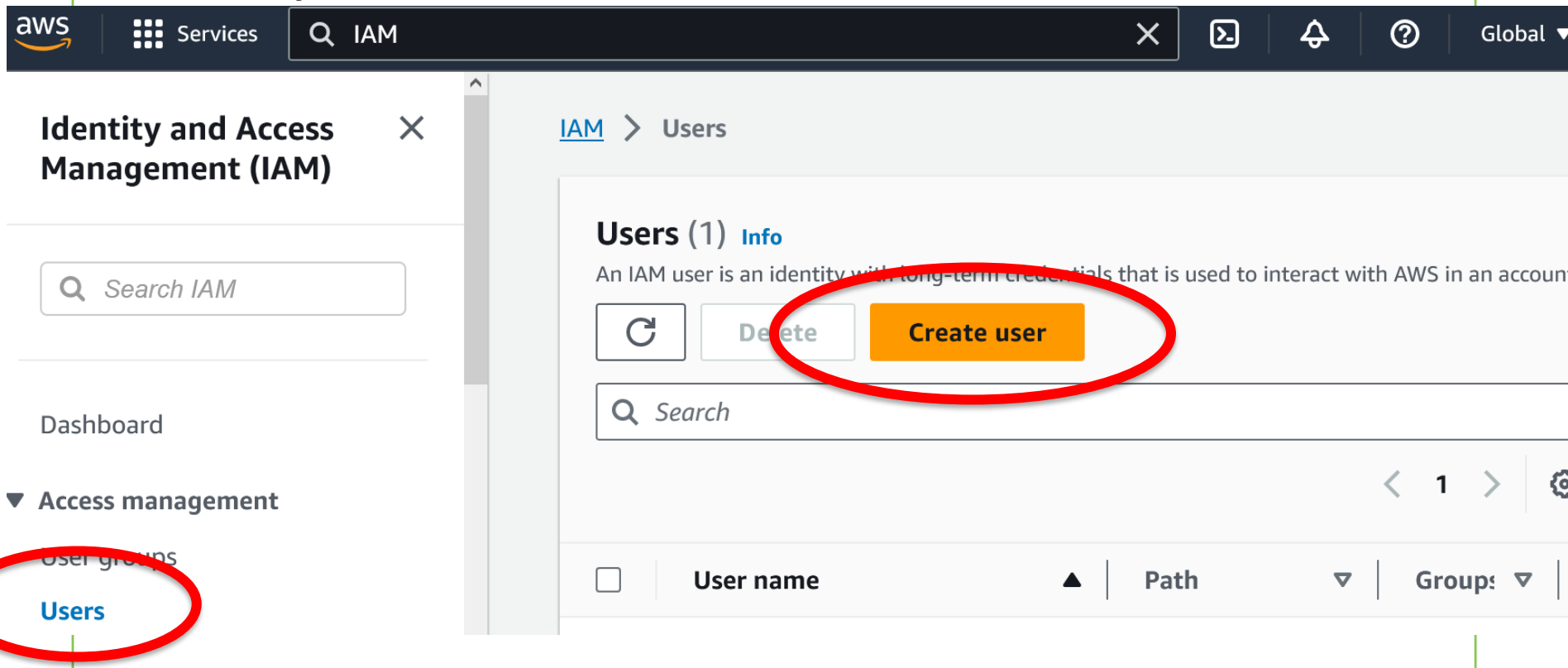
Create admin IAM user and user group (2)

- **Create user group Administrators**
  - **Search IAM to open IAM Dashboard; Click User Group and then Create Group**



Create admin IAM user and user group (3)

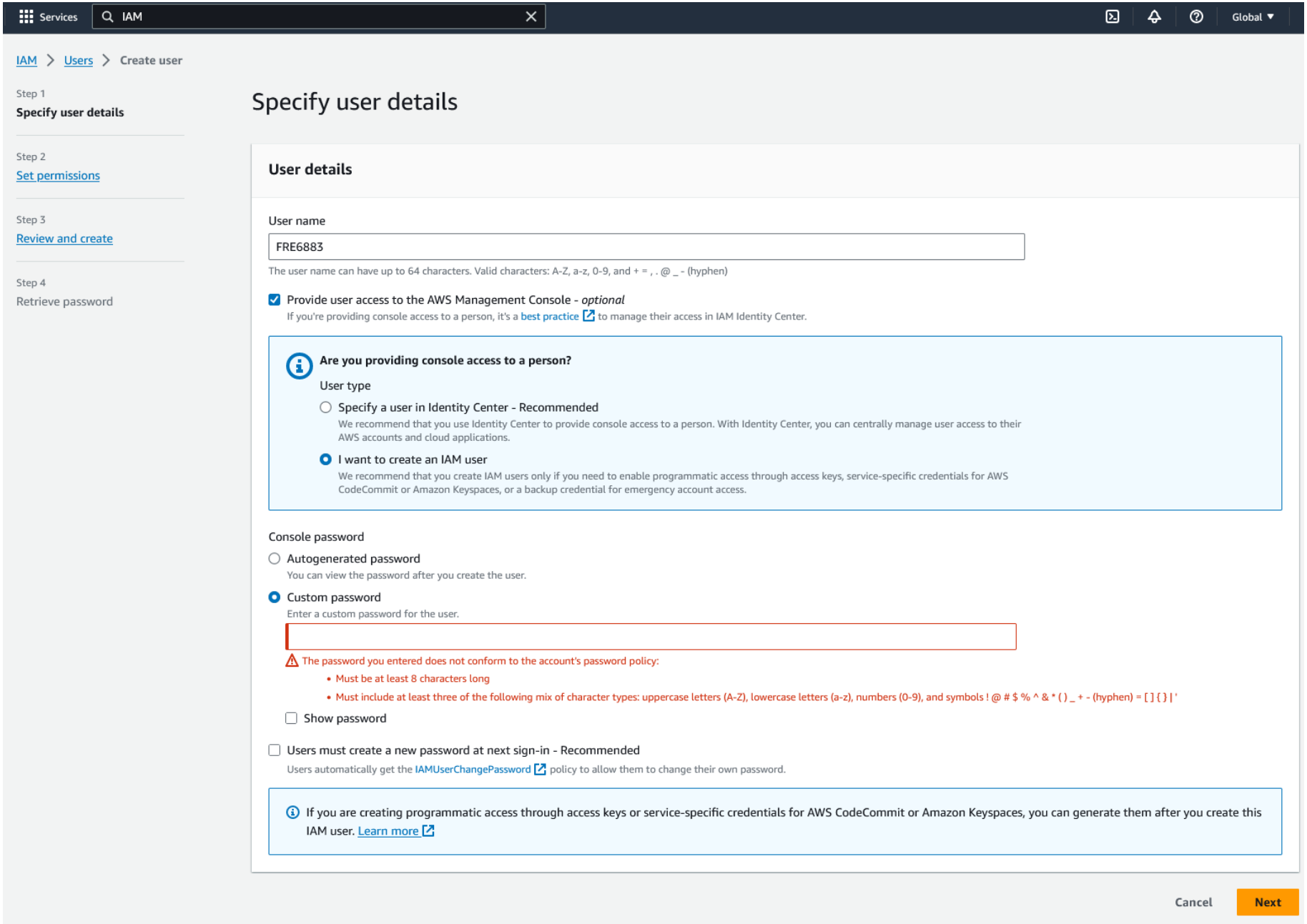
- Create your IAM admin user

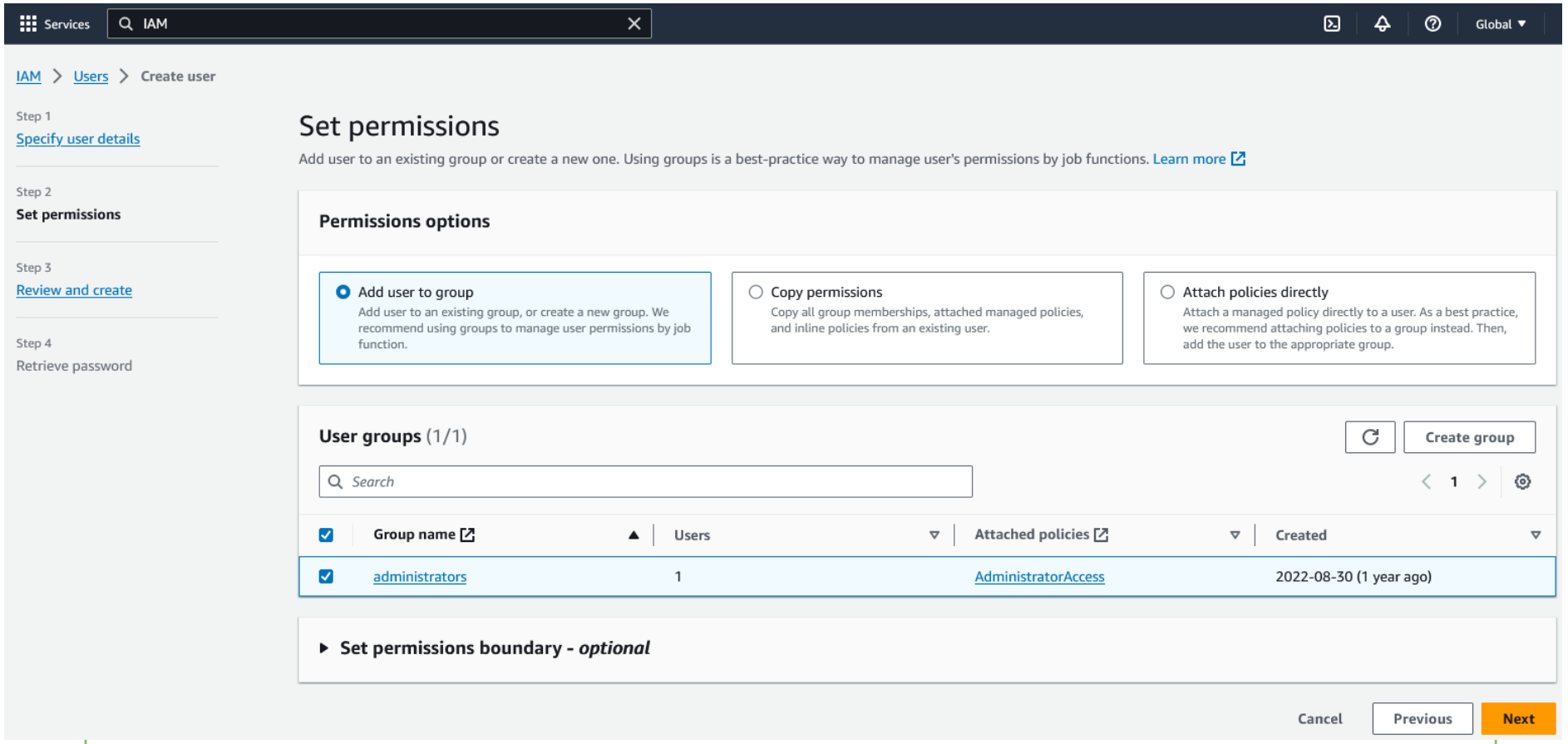


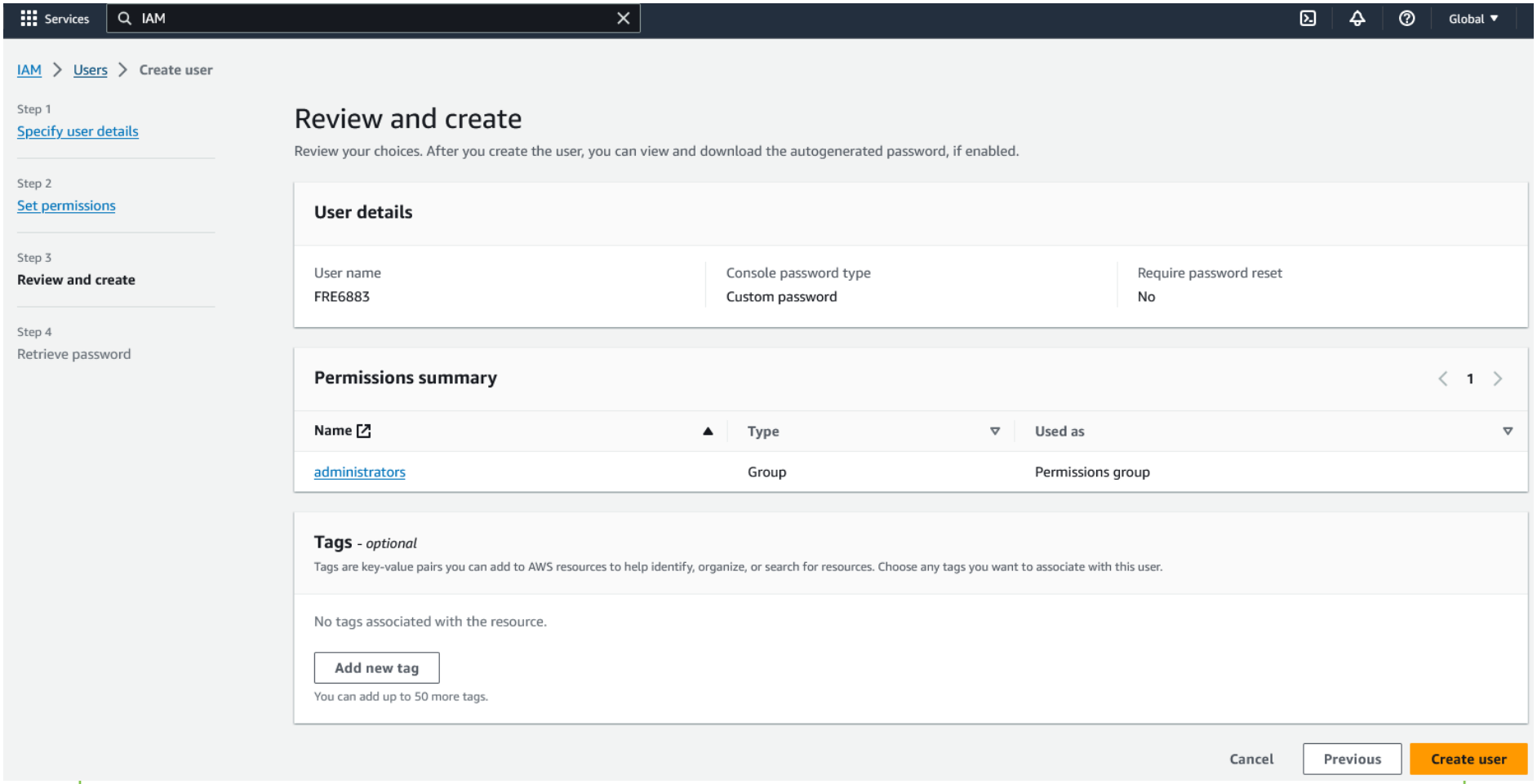
NEW YORK UNIVERSITY

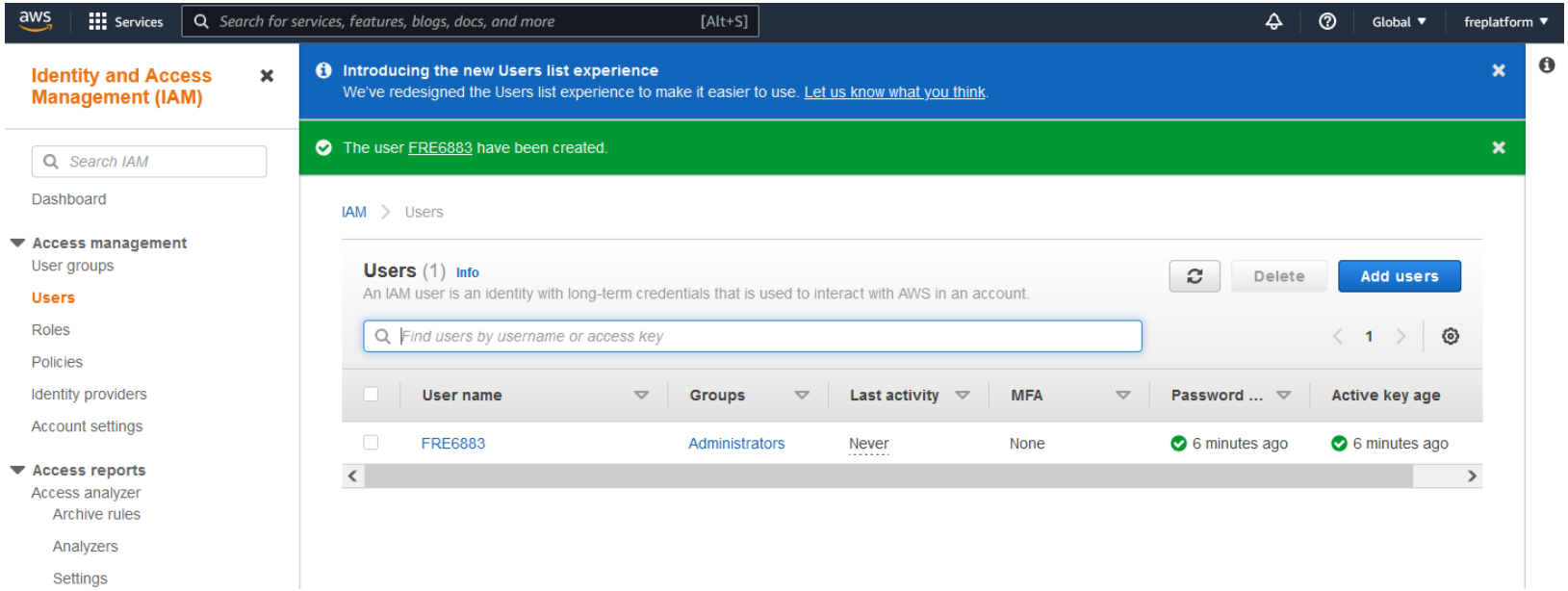
NYU·poly
POLYTECHNIC INSTITUTE OF NEW YORK UNIVERSITY

Leading invention, innovation and entrepreneurship

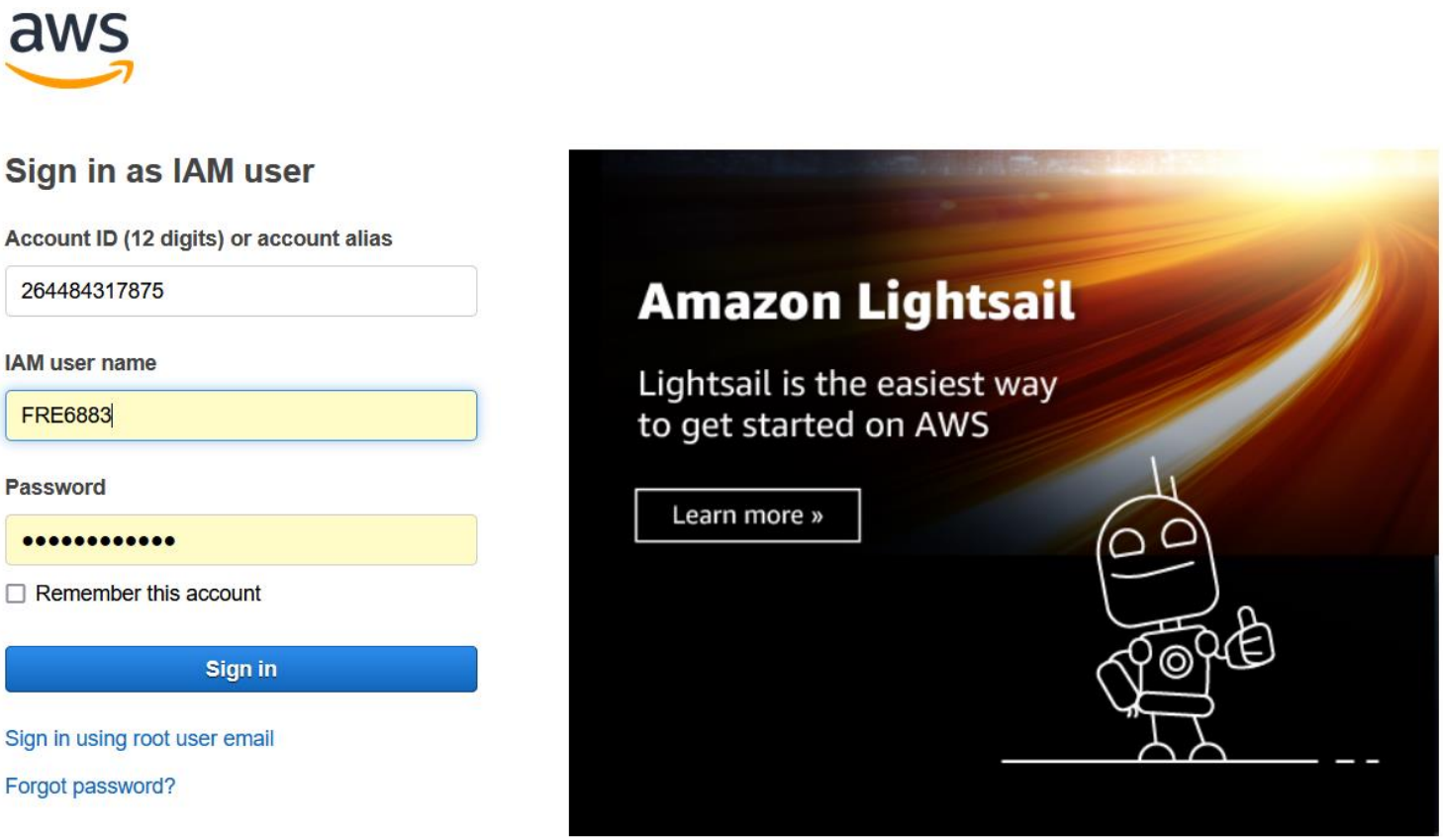

Services
IAM
Global
IAM > Users > Create user
Step 1
Specify user details
Step 2
Set permissions
Step 3
Review and create
Step 4
Retrieve password
Specify user details
User details
User name
FRE6883
The user name can have up to 64 characters. Valid characters: A-Z, a-z, 0-9, and + = , . @ _ - (hyphen)
Provide user access to the AWS Management Console - optional
If you're providing console access to a person, it's a best practice to manage their access in IAM Identity Center.
Are you providing console access to a person?
User type
Specify a user in Identity Center - Recommended
We recommend that you use Identity Center to provide console access to a person. With Identity Center, you can centrally manage user access to their AWS accounts and cloud applications.
I want to create an IAM user
We recommend that you create IAM users only if you need to enable programmatic access through access keys, service-specific credentials for AWS CodeCommit or Amazon Keyspaces, or a backup credential for emergency account access.
Console password
Autogenerated password
You can view the password after you create the user.
Custom password
Enter a custom password for the user.
The password you entered does not conform to the account's password policy:
Must be at least 8 characters long
Must include at least three of the following mix of character types: uppercase letters (A-Z), lowercase letters (a-z), numbers (0-9), and symbols ! @ # $ % ^ & * ( ) _ + - (hyphen) = [ ] { } | '
Show password
Users must create a new password at next sign-in - Recommended
Users automatically get the IAMUserChangePassword policy to allow them to change their own password.
If you are creating programmatic access through access keys or service-specific credentials for AWS CodeCommit or Amazon Keyspaces, you can generate them after you create this IAM user. Learn more
Cancel
Next

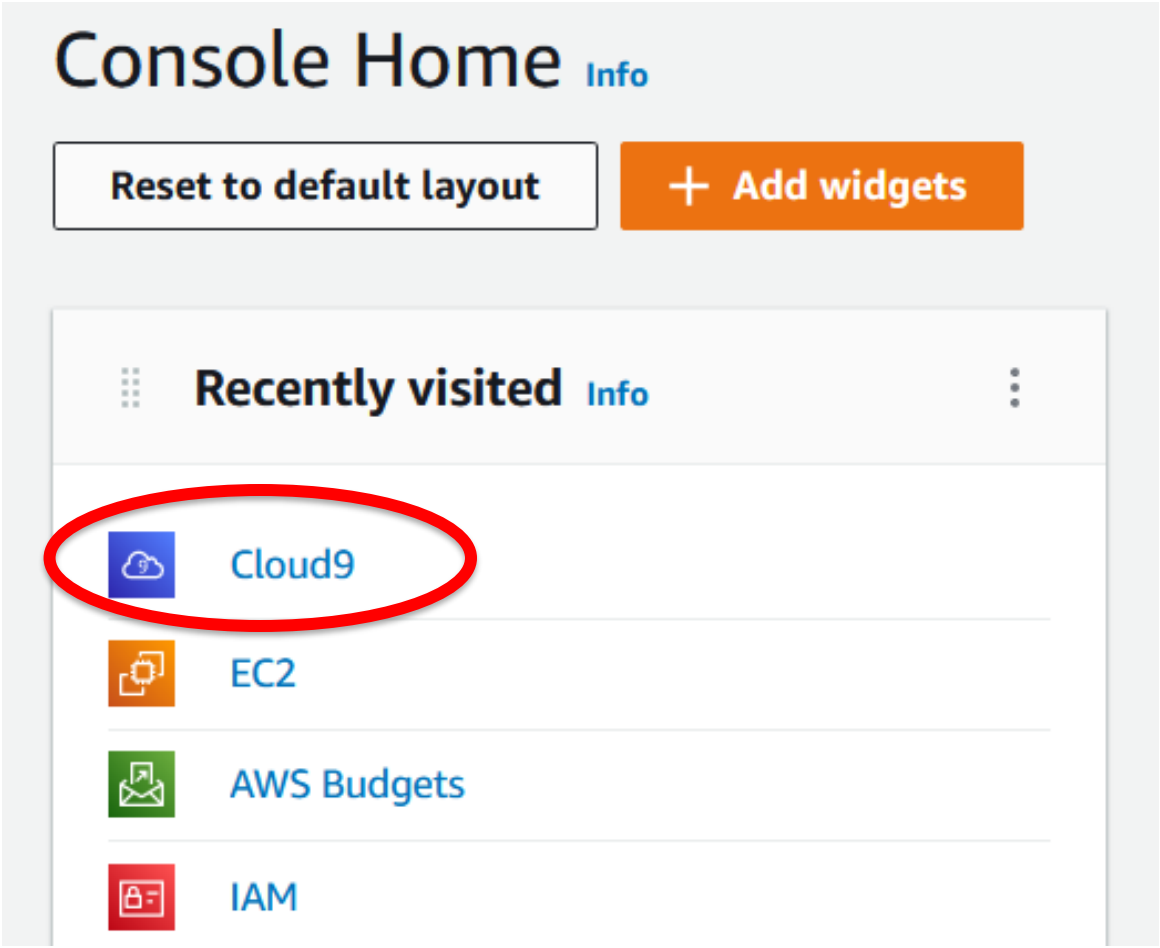

Services
IAM
Global
IAM > Users > Create user
Step 1
Specify user details
Step 2
Set permissions
Step 3
Review and create
Step 4
Retrieve password
Set permissions
Add user to an existing group or create a new one. Using groups is a best-practice way to manage user's permissions by job functions. Learn more
Permissions options
Add user to group
Add user to an existing group, or create a new group. We recommend using groups to manage user permissions by job function.
Copy permissions
Copy all group memberships, attached managed policies, and inline policies from an existing user.
Attach policies directly
Attach a managed policy directly to a user. As a best practice, we recommend attaching policies to a group instead. Then, add the user to the appropriate group.
User groups (1/1)
Create group
Search
1
Group name
Users
Attached policies
Created
administrators
1
AdministratorAccess
2022-08-30 (1 year ago)
Set permissions boundary - optional
Cancel
Previous
Next


Services
IAM
Global
IAM > Users > Create user
Step 1
Specify user details
Step 2
Set permissions
Step 3
Review and create
Step 4
Retrieve password
Review and create
Review your choices. After you create the user, you can view and download the autogenerated password, if enabled.
User details
User name
FRE6883
Console password type
Custom password
Require password reset
No
Permissions summary
1
Name
Type
Used as
administrators
Group
Permissions group
Tags - optional
Tags are key-value pairs you can add to AWS resources to help identify, organize, or search for resources. Choose any tags you want to associate with this user.
No tags associated with the resource.
Add new tag
You can add up to 50 more tags.
Cancel
Previous
Create user

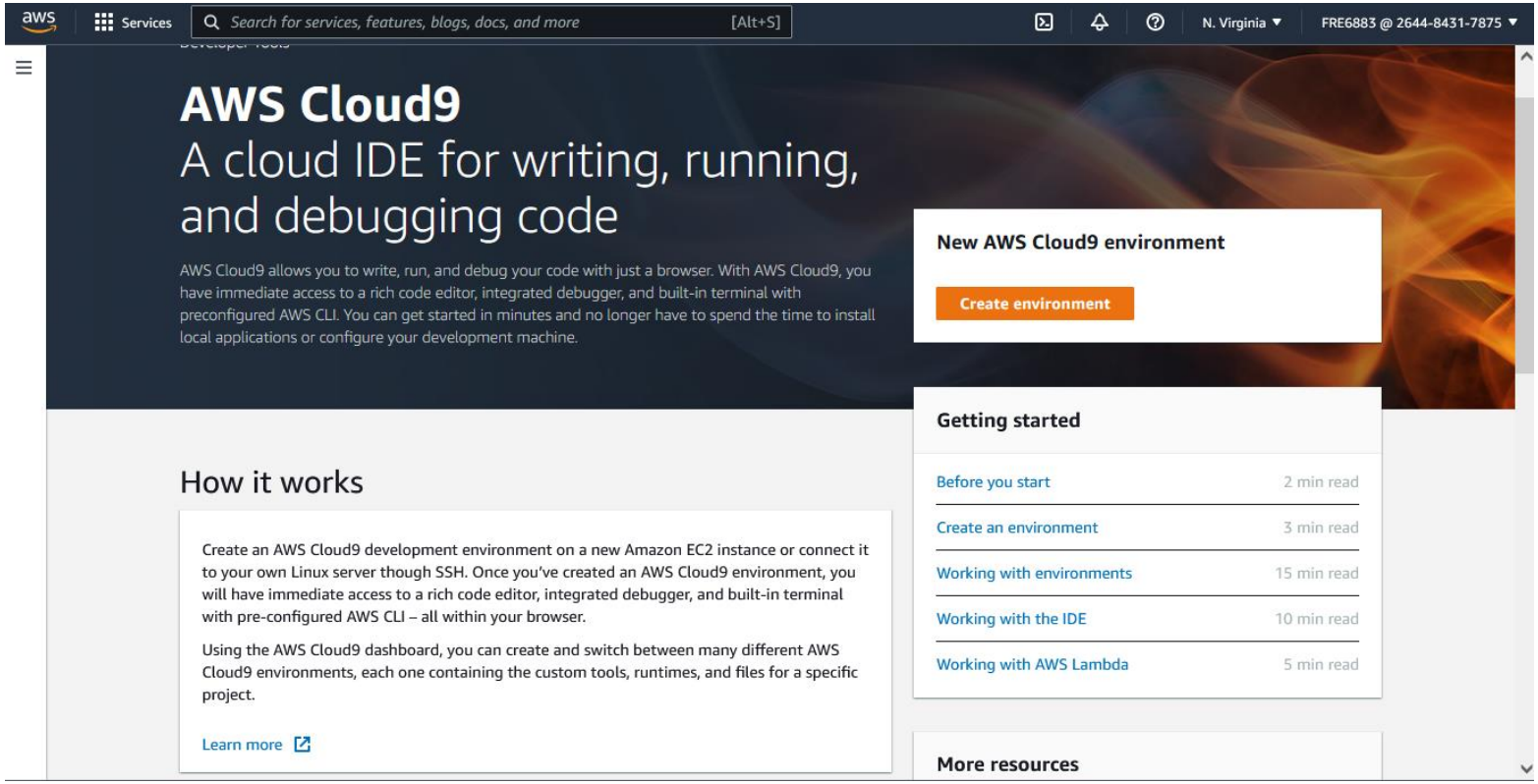

aws
Services
Search for services, features, blogs, docs, and more
[Alt+S]
Global
freplatform
Identity and Access Management (IAM)
Introducing the new Users list experience
We've redesigned the Users list experience to make it easier to use. Let us know what you think.
The user FRE6883 have been created.
Search IAM
Dashboard
Access management
User groups
Users
Roles
Policies
Identity providers
Account settings
Access reports
Access analyzer
Archive rules
Analyzers
Settings
IAM > Users
Users (1) Info
An IAM user is an identity with long-term credentials that is used to interact with AWS in an account.
Delete
Add users
Find users by username or access key
1
User name
Groups
Last activity
MFA
Password ...
Active key age
FRE6883
Administrators
Never
None
6 minutes ago
6 minutes ago

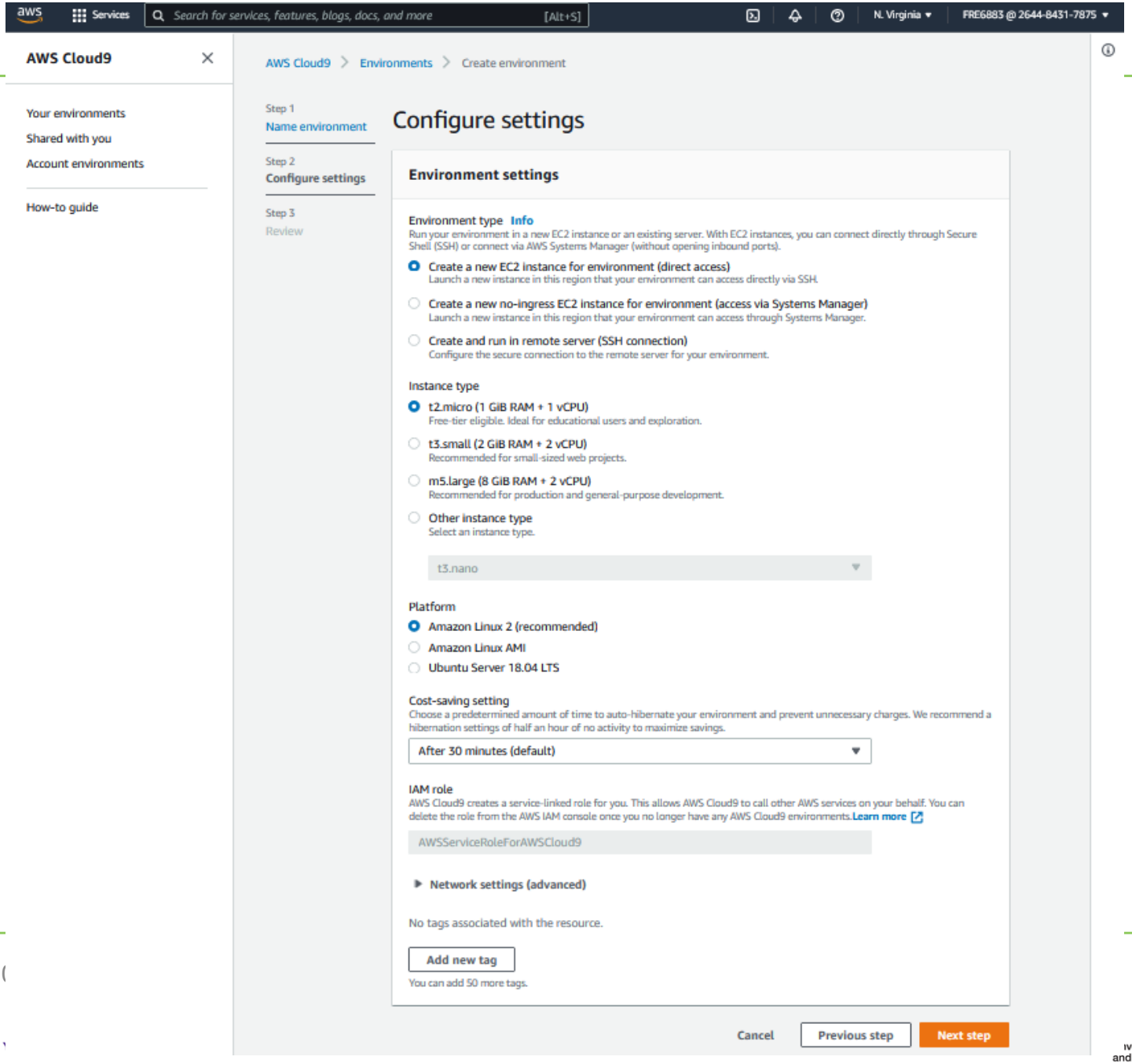
Sign in as IAM user

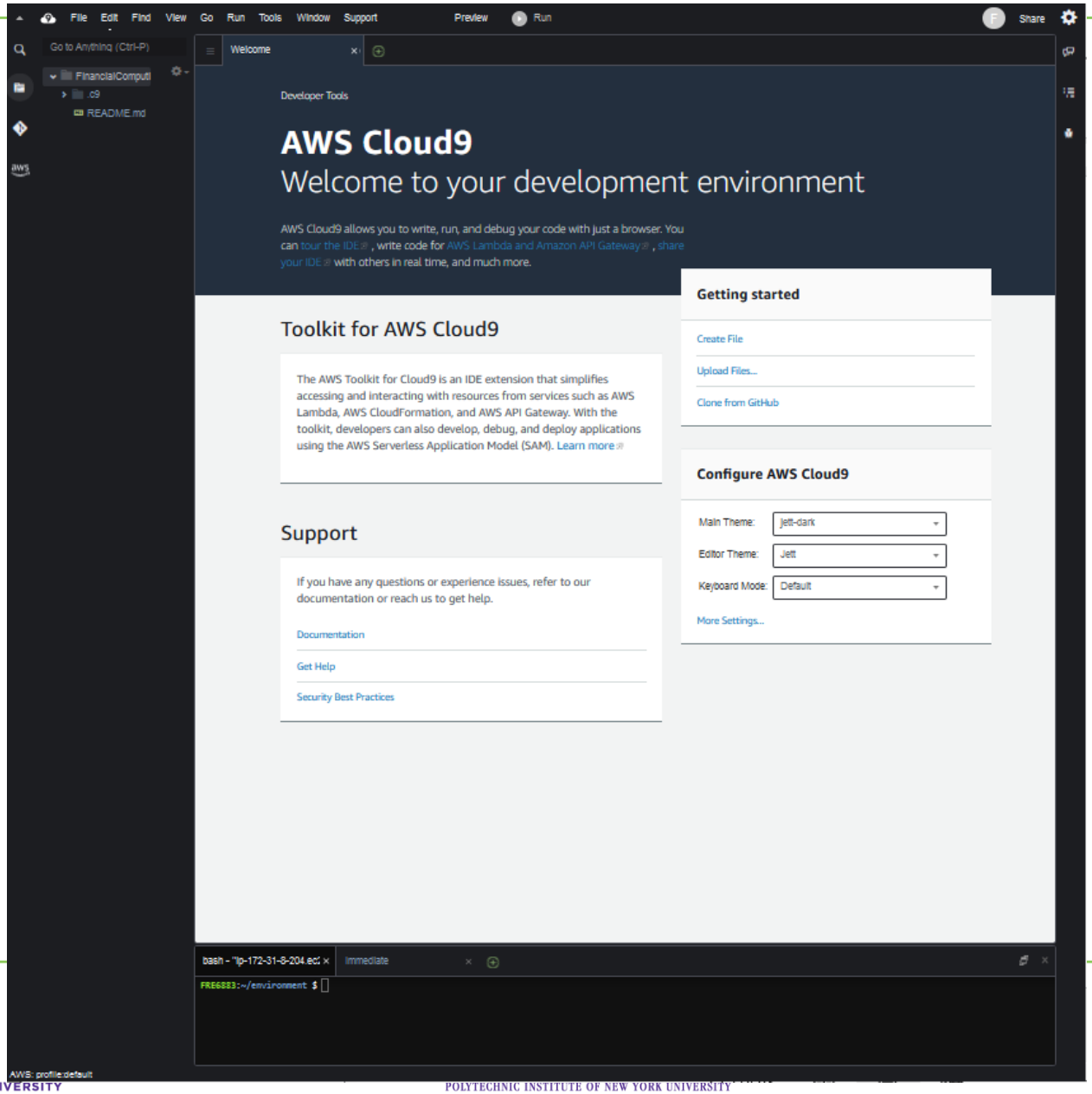



Console Home Info
Reset to default layout
+ Add widgets
Recently visited Info
Cloud9
EC2
AWS Budgets
IAM

Create AWS Cloud9 C++ coding env



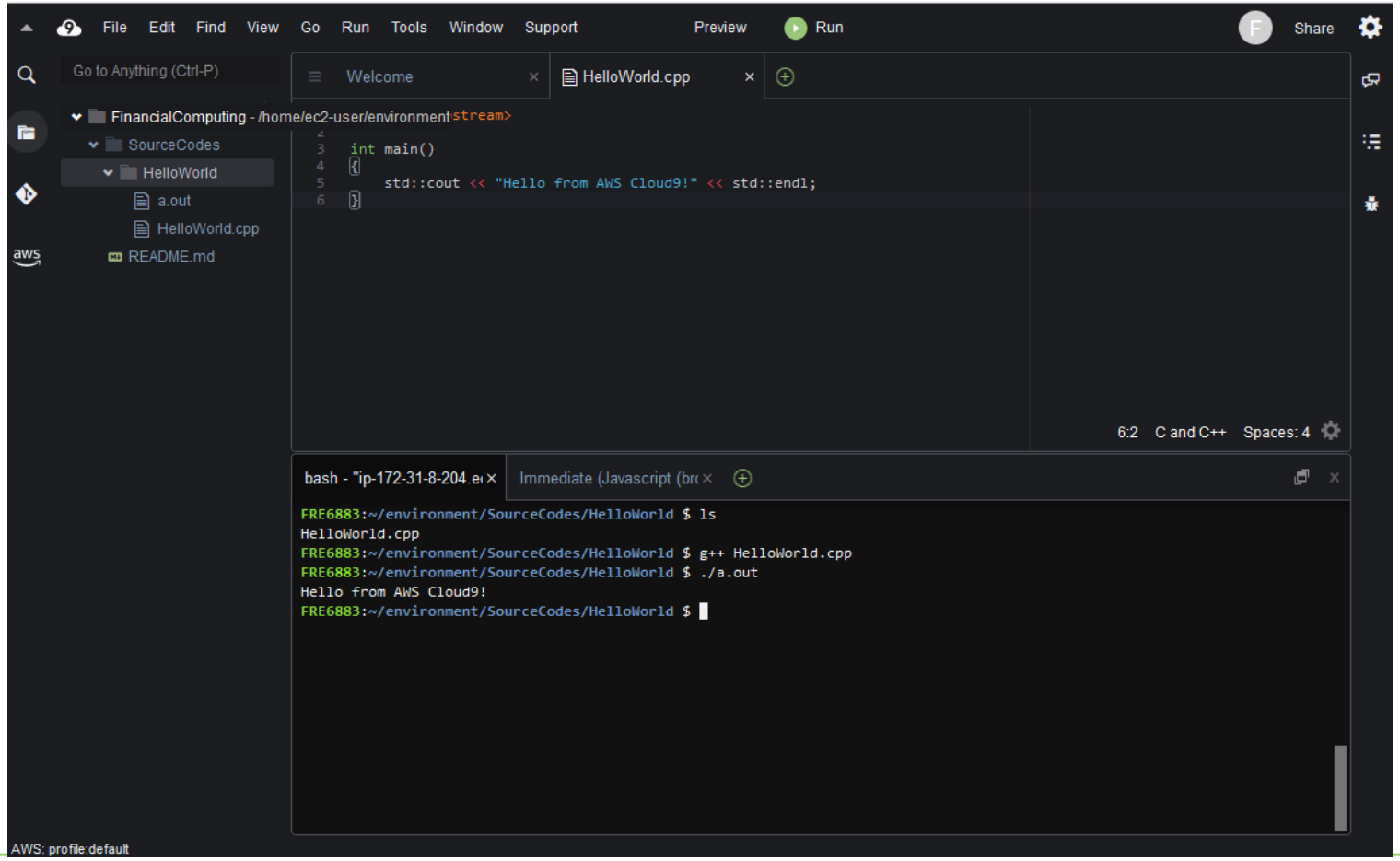

aws
Services
Search for services, features, blogs, docs, and more
[Alt+S]
N. Virginia
FRE6883 @ 2644-8431-7875
AWS Cloud9
Your environments
Shared with you
Account environments
How-to guide
AWS Cloud9 > Environments > Create environment
Step 1
Name environment
Step 2
Configure settings
Step 3
Review
Configure settings
Environment settings
Environment type Info
Run your environment in a new EC2 instance or an existing server. With EC2 instances, you can connect directly through Secure Shell (SSH) or connect via AWS Systems Manager (without opening inbound ports).
Create a new EC2 instance for environment (direct access)
Launch a new instance in this region that your environment can access directly via SSH.
Create a new no-ingress EC2 instance for environment (access via Systems Manager)
Launch a new instance in this region that your environment can access through Systems Manager.
Create and run in remote server (SSH connection)
Configure the secure connection to the remote server for your environment.
Instance type
t2.micro (1 GiB RAM + 1 vCPU)
Free-tier eligible. Ideal for educational users and exploration.
t3.small (2 GiB RAM + 2 vCPU)
Recommended for small-sized web projects.
m5.large (8 GiB RAM + 2 vCPU)
Recommended for production and general-purpose development.
Other instance type
Select an instance type.
t3.nano
Platform
Amazon Linux 2 (recommended)
Amazon Linux AMI
Ubuntu Server 18.04 LTS
Cost-saving setting
Choose a predetermined amount of time to auto-hibernate your environment and prevent unnecessary charges. We recommend a hibernation settings of half an hour of no activity to maximize savings.
After 30 minutes (default)
IAM role
AWS Cloud9 creates a service-linked role for you. This allows AWS Cloud9 to call other AWS services on your behalf. You can delete the role from the AWS IAM console once you no longer have any AWS Cloud9 environments. Learn more
AWSServiceRoleForAWSCloud9
Network settings (advanced)
No tags associated with the resource.
Add new tag
You can add 50 more tags.
Cancel
Previous step
Next step


File Edit Find View Go Run Tools Window Support
Preview
Run
Share
Go to Anything (Ctrl-P)
FinancialComputi
c9
README.md
Welcome
Developer Tools
AWS Cloud9
Welcome to your development environment
AWS Cloud9 allows you to write, run, and debug your code with just a browser. You can tour the IDE, write code for AWS Lambda and Amazon API Gateway, share your IDE with others in real time, and much more.
Toolkit for AWS Cloud9
The AWS Toolkit for Cloud9 is an IDE extension that simplifies accessing and interacting with resources from services such as AWS Lambda, AWS CloudFormation, and AWS API Gateway. With the toolkit, developers can also develop, debug, and deploy applications using the AWS Serverless Application Model (SAM). Learn more
Support
If you have any questions or experience issues, refer to our documentation or reach us to get help.
Documentation
Get Help
Security Best Practices
Getting started
Create File
Upload Files...
Clone from GitHub
Configure AWS Cloud9
Main Theme: jett-dark
Editor Theme: Jett
Keyboard Mode: Default
More Settings...
bash - "ip-172-31-8-204.ec2
immediate
FRE6883:~/environment $
AWS: profile:default

Your 1st C++ Program: HelloWorld

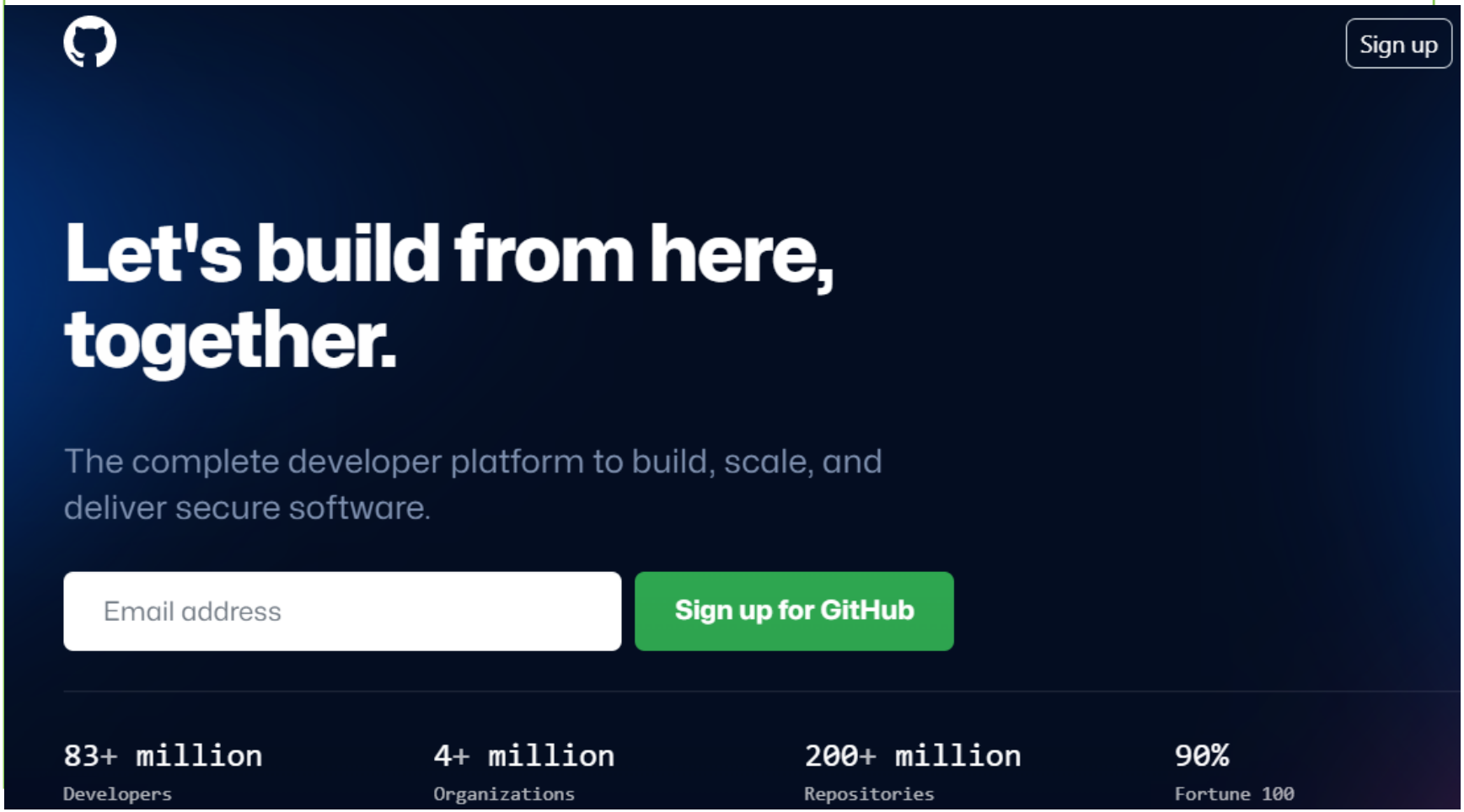
- In your Cloud9 env, create a new folder, and name it as ***HelloWorld***
- Create a new file Using ***New File from Template and then C++ file***
- Save the file as ***HelloWorld.cpp*** in the folder HelloWorld.
- On the command line, type the following3 commands:
  - ***cd HelloWorld***
  - ***g++ HelloWorld.cpp***
  - ***./a.out***

Your 1st C++ Program: HelloWorld (Continued)



Create GitHub account

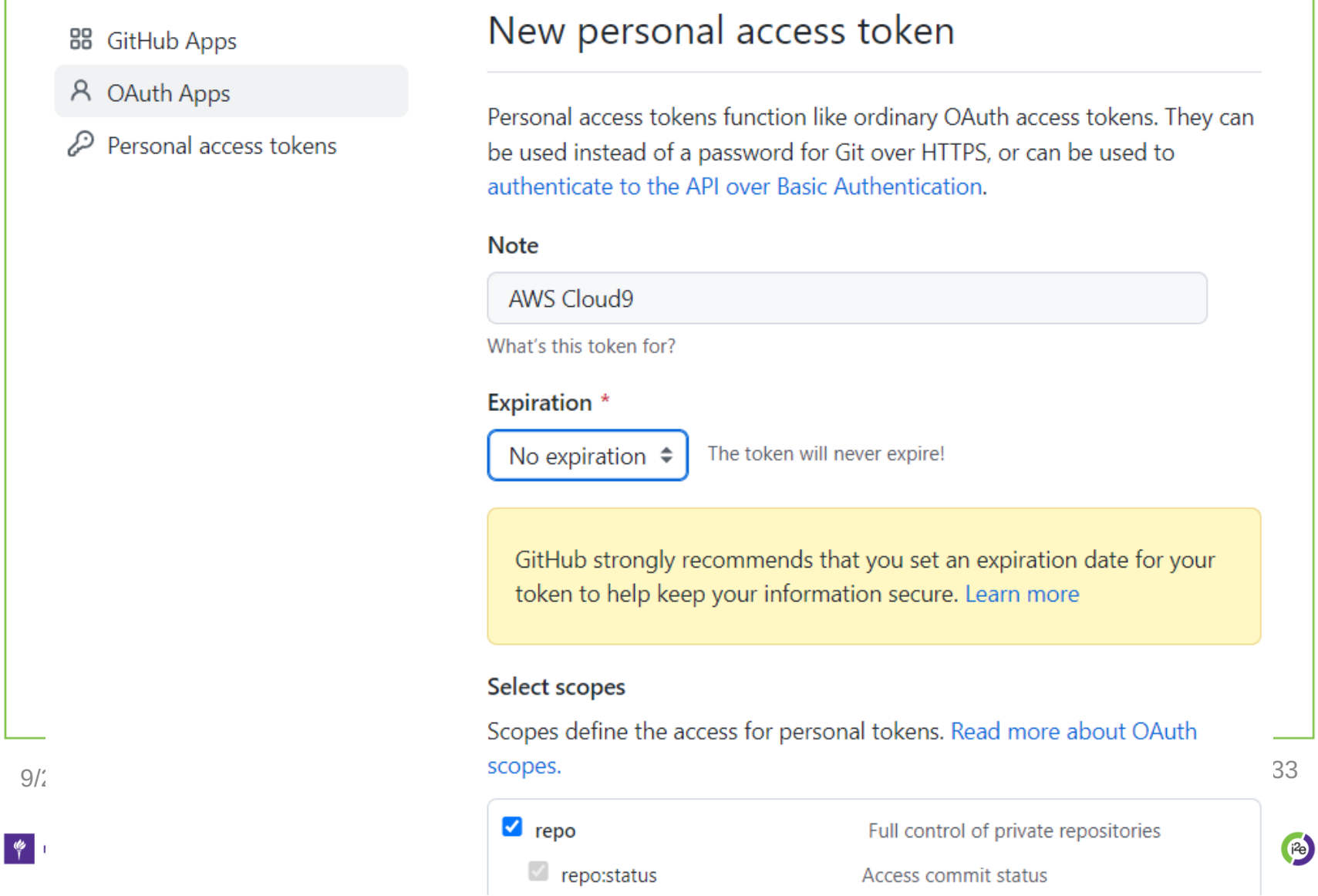
github.com



Create GitHub Personal Access Token (PAT)

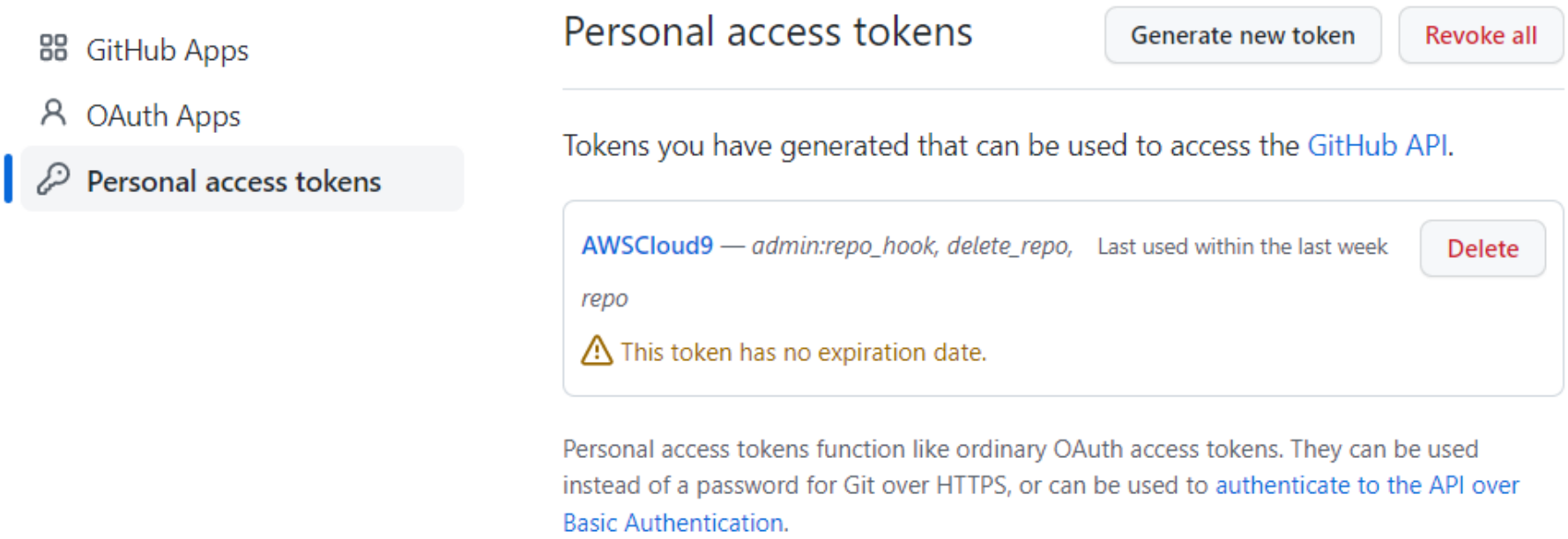
- Login your GitHub account, click your name at the right top corner and then settings
- Click Developer settings on the bottom of left panel.
- Click Personal access tokens and Select Tokens.
- Click Generate new token (Classic)
- For the new token, make sure select the following:
  - ***admin:repo_hook, delete_repo, repo***

Create GitHub PAT (Continued)



Create GitHub PAT (Continued)

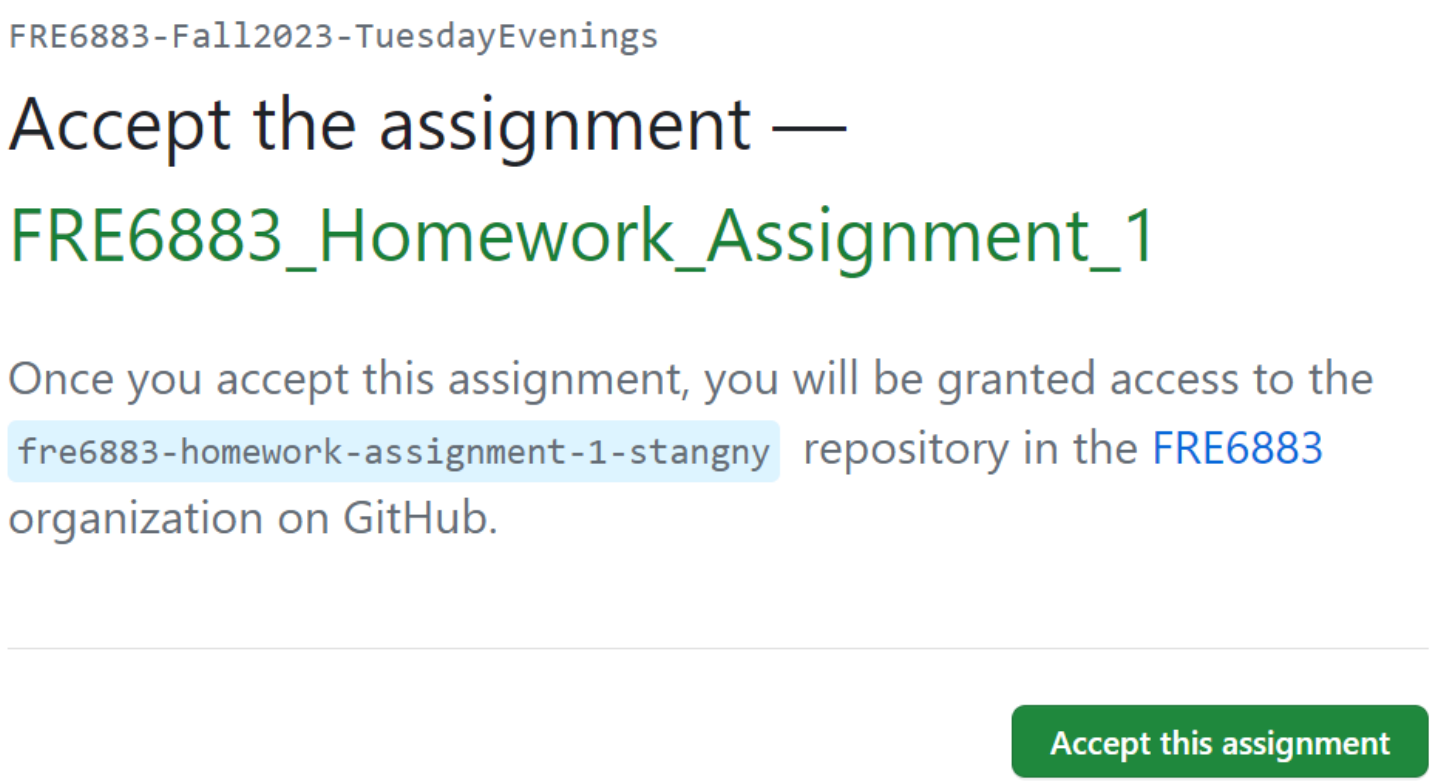
- **Make sure copy/paste your PAT token and save it somewhere as you will not be able to see it anymore.**
- **The PAT token will be used for clone the Git repository into your AWS Cloud9 and push your homework from Cloud9 to GitHub.**



Join FRE6883 GitHub Classroom

- Login into your GitHub account and Join FRE6883 classroom via the following links:
  - **Students in Tuesday Session:**
  - https://classroom.github.com/a/NAcVtKky
  - **Students in Saturday Session:**
  - https://classroom.github.com/a/u79tQ6Dn
  - Associate your name with your GitHub Account **(Double Check to make sure select right name from the roster)**
- Click Accept this Assignment
- Click the assignment repository such as the following:

Homework Assignment Repository



Homework Assignment Repository (Continue)

You accepted the assignment, **FRE6883_Homework_Assignment_1** .
We're configuring your repository now. This may take a few minutes to complete. Refresh this page to see updates.

Your assignment is due by **Sep 19, 2023, 18:00 EDT**

Note: You may receive an email invitation to join FRE6883 on your behalf. No further action is necessary.

Homework Assignment Repository (Continue)

You're ready to go!

You accepted the assignment, **FRE6883_Homework_Assignment_1**.

Your assignment repository has been created:

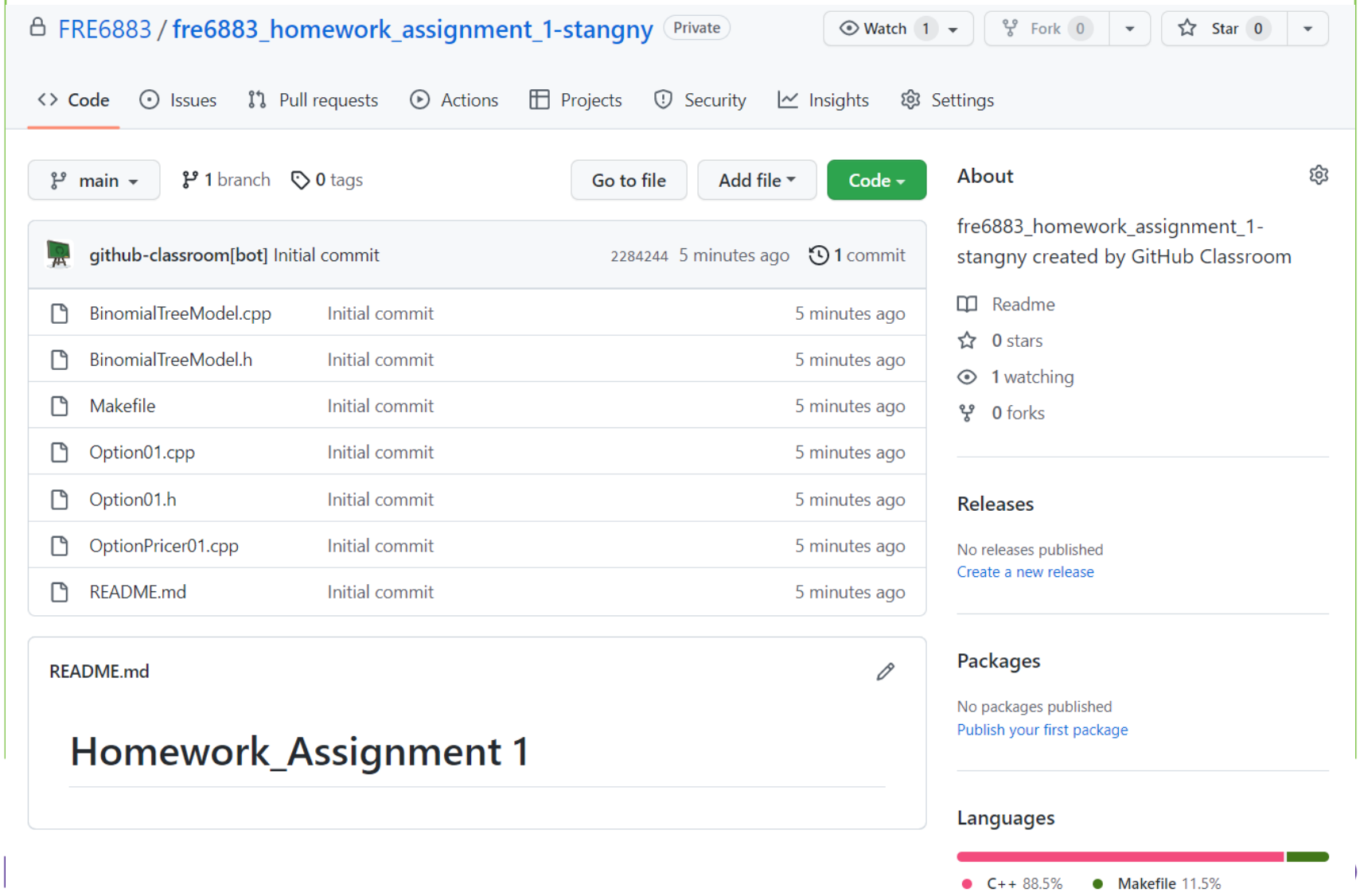
`https://github.com/FRE6883/fre6883-homework-assignment-1-stangny`

We've configured the repository associated with this assignment (update).

Your assignment is due by **Sep 19, 2023, 18:00 EDT**

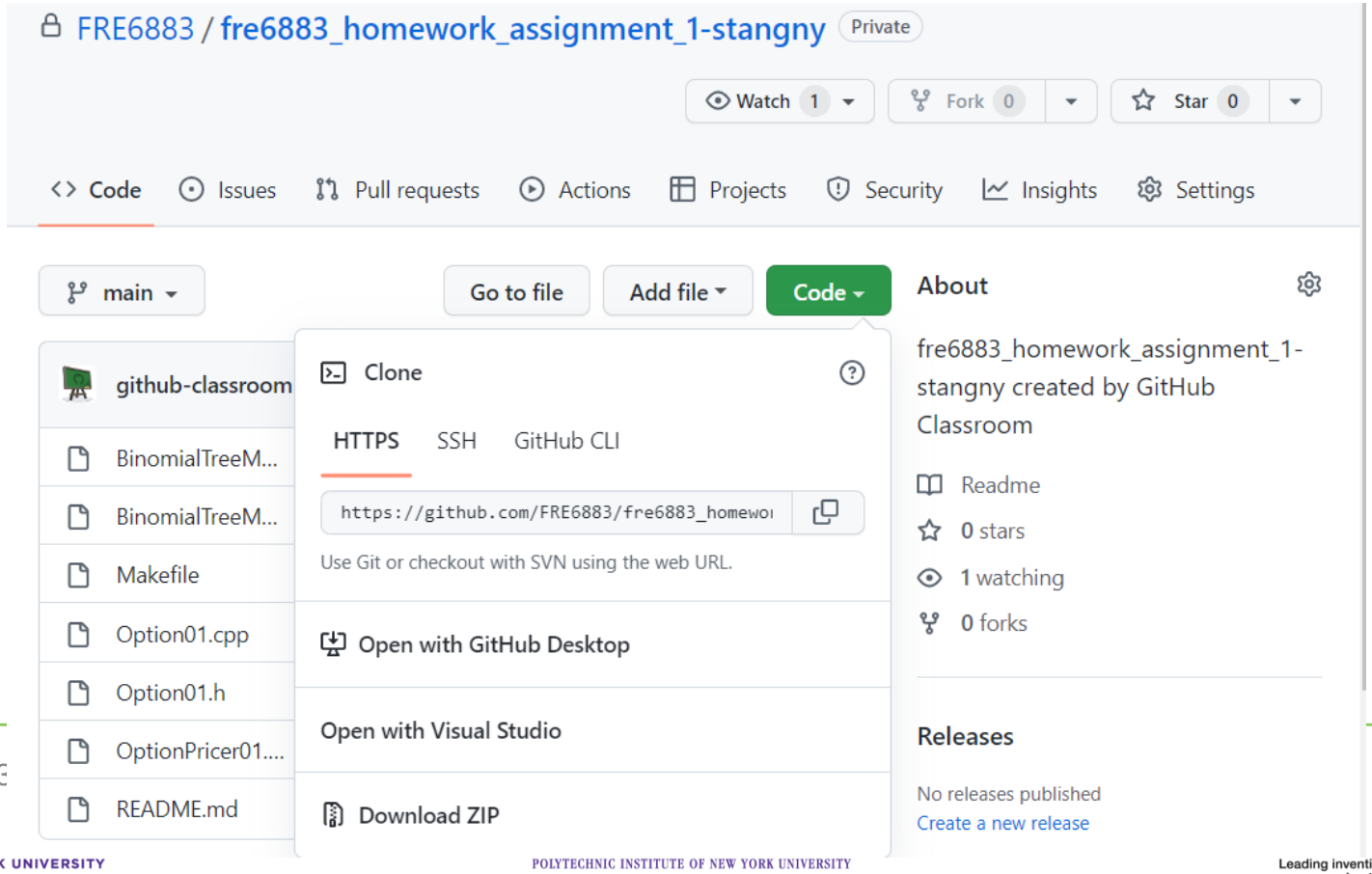
Note: You may receive an email invitation to join FRE6883 on your behalf. No further action is necessary.

Homework Assignment Repository (continued)



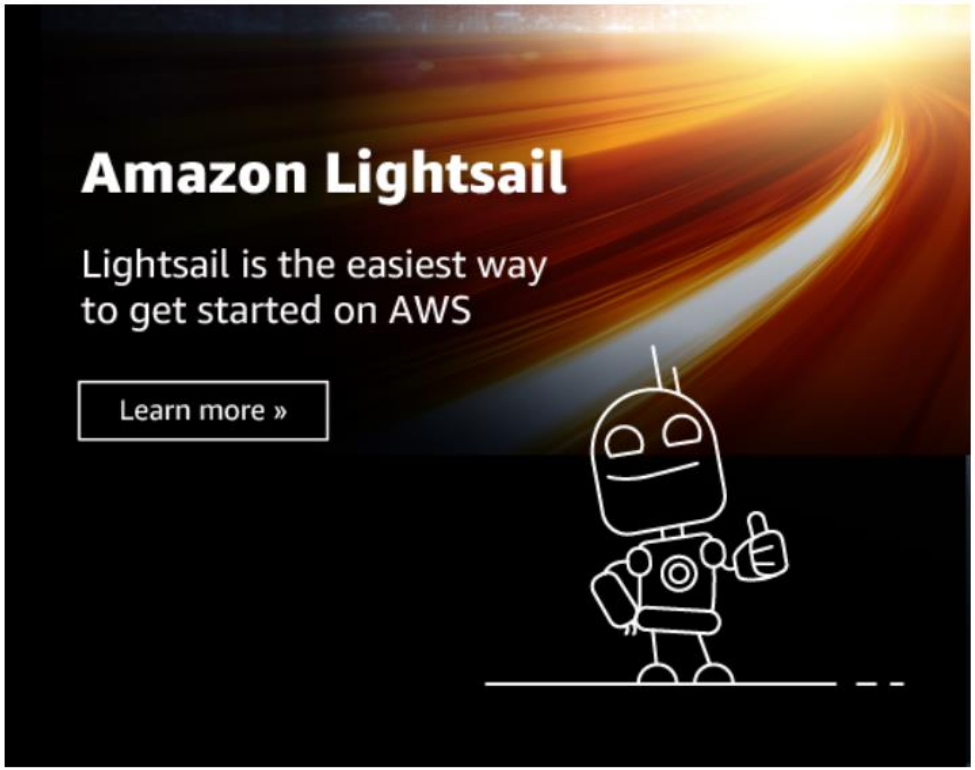
Clone GitHub Homework Repository to Cloud9

From your Homework Assignment Repository, click Code and copy the HTTPS link:



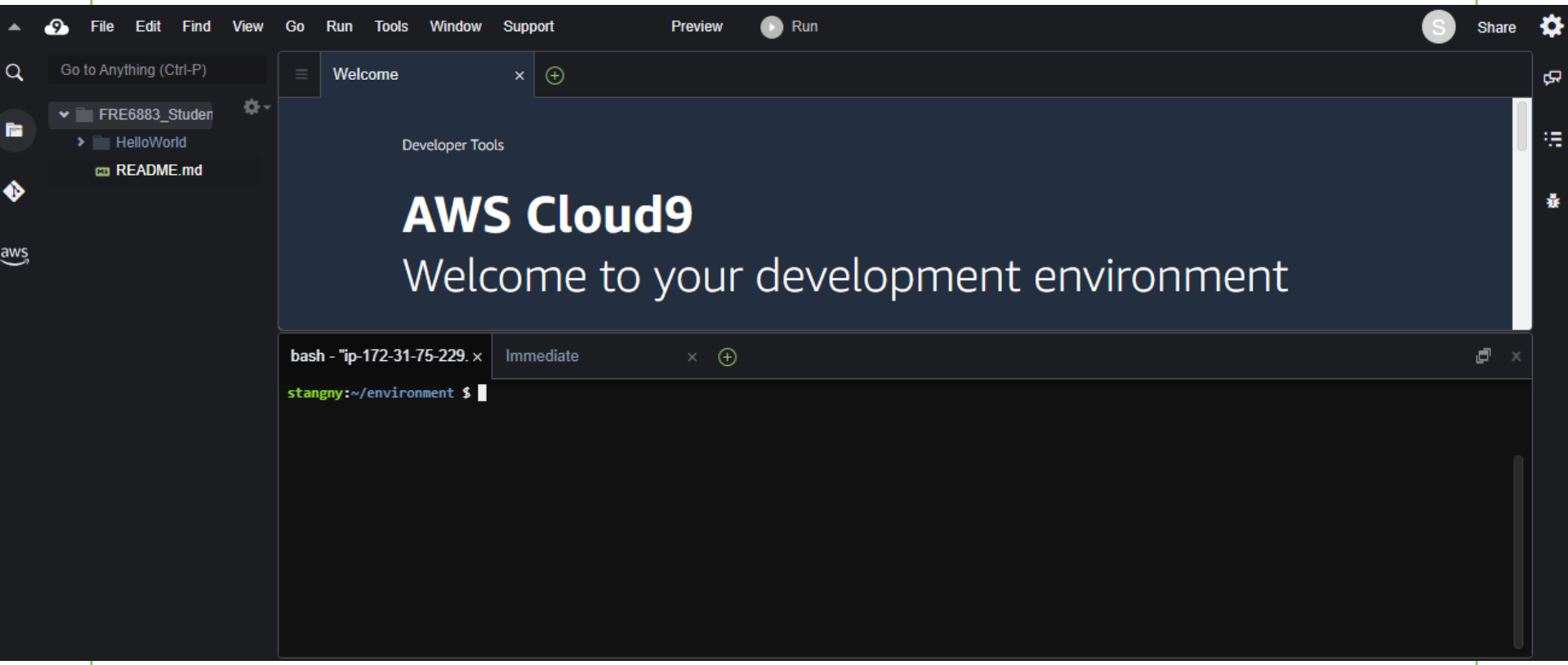
Clone Homework Repo to Cloud9 (continued)

- Sign in your AWS Cloud9 as the IAM user:



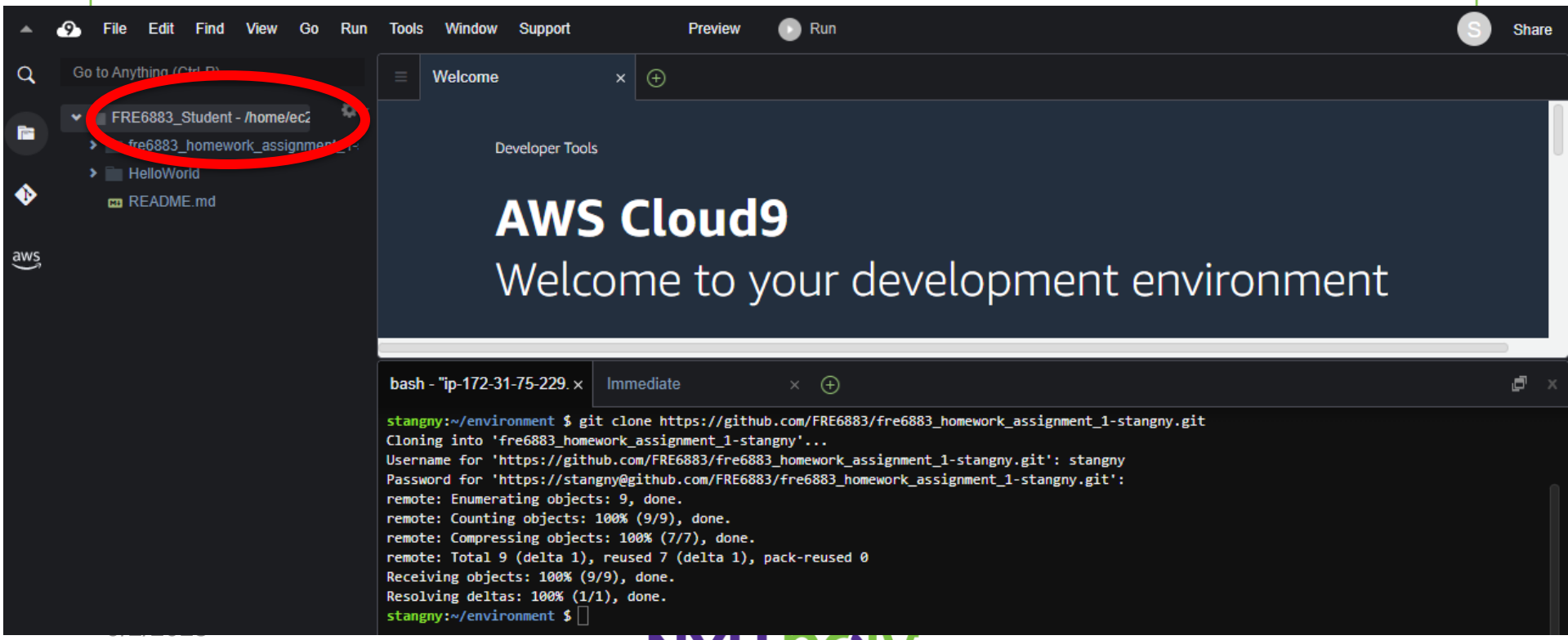
Clone Homework Repo to Cloud9 (continued)

- Start your Cloud9 Env:

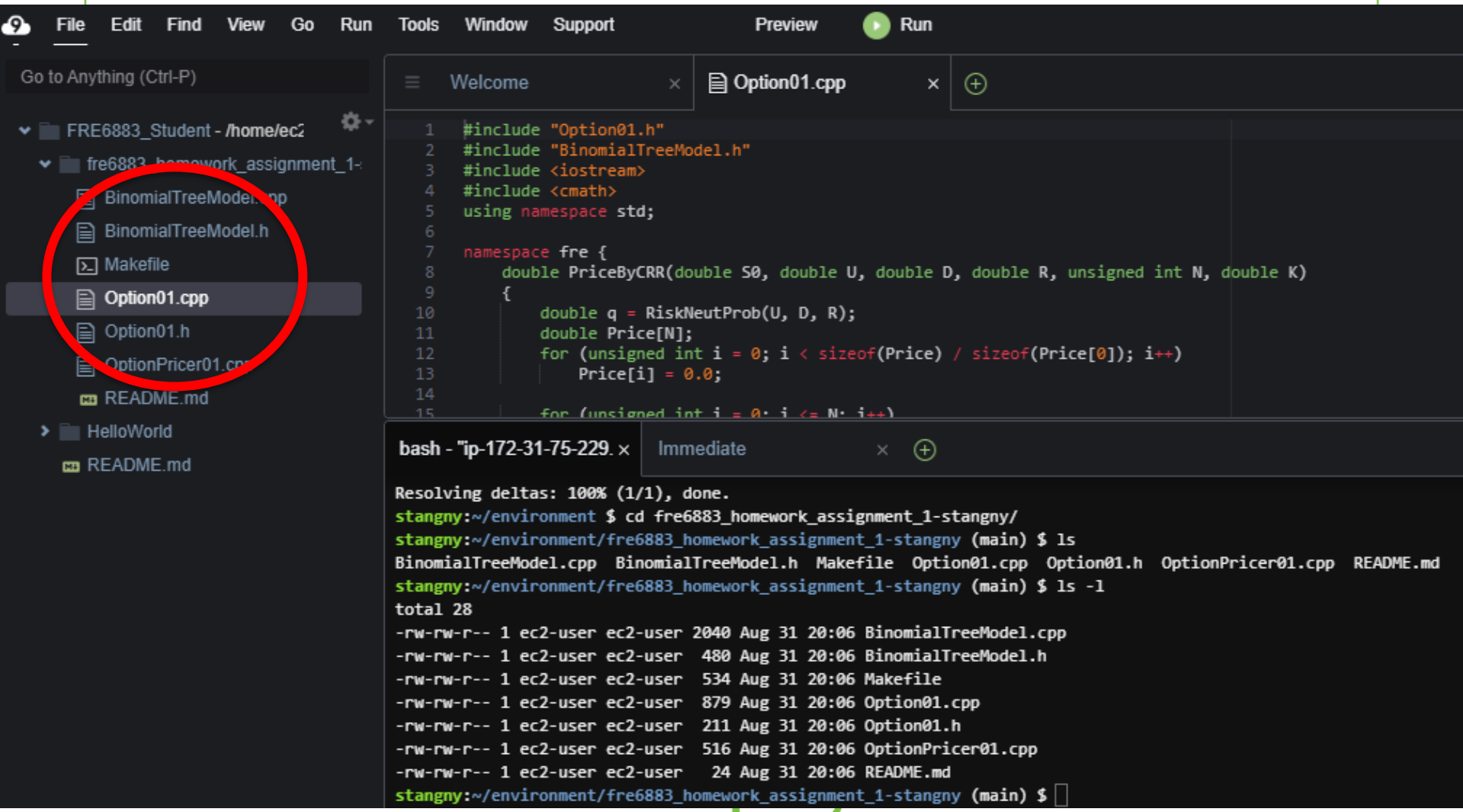


Clone Homework Repo to Cloud9 (continued)

- Clone the Homework Repo using the HTTPS link you copied such as:
- **git clone https://github.com/FRE6883/fre6883_homework_assignment_1-stangny.git**
- Enter your GitHub username and **your PAT** as the password



Verify homework source codes in your Cloud9



Compile, Build and Run