ASSIGNMENT 2 FRONT SHEET

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Unit number and title	Unit 16: Cloud computing		
Submission date		**Date Received 1st submission**	
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Student declaration I certify that the assignment submission is entirely my own work and I fully understand the consequences of plagiarism. I understand that making a false declaration is a form of malpractice.			
		Student's signature	

Grading grid

P5	P6	P7	P8	M3	M4	D2	D3

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1. Introduction.

In assignment 2, my role as a developer is to build a sales website with PaaS-based features and data for ATN within the service requirement: application platform: Heroku, programming language: PHP, HTML, database: PostgreSQL pgAdmin4, Tools needed: GitHub, Visual Studio Code and framework: Bootstrap The website is built and deployed on Heroku is a cloud platform as a service (PaaS). In section 2 outlined the required frameworks and open source tools for ATN Company and their relationship to build a website for ATN. In section 2, I showed you the necessary frameworks and open source tools and their relationship to build a website for ATN. Then from the tools above, steps were taken to set up, build and deploy the site for ATN, and finally in part 2, it shows the ATN toy site within the functions. Section 3 outlined common problems of cloud computing including: private, public, community and hybrid cloud and solutions for them. Next, sections 4 and section 5 point out the problems of security risks and cloud security mechanisms in cloud computing and methods to ensure Data security. These 2 sections provide readers with an overview of the problem and solution of security cloud.

2. Develop cloud computing solutions for ATN by using service providers Framework and open source tools.

2.1 Framework and open source tools for ATN Company.

In assignment 1. The best suitable service for ATN is PaaS and HEROKU is a platform as a service (PaaS) that enables ATN company developers to build, run, and operate website entirely in the cloud. Heroku supports every step of the life cycle of the website that ATN has built. Heroku helps the website run, manage and scale easily with the PAAS platform it is using. Besides, Heroku Postgres provides reliable database options for ATN to use. HEROKU and PostgresSQL allow an atn company to restore the company's source code and database to its previous state immediately.

Figure 1 Heroku cloud platform (James Lindenbaum, 2007).

PostgreSQL is used as database server for ATN Company. Therefore, to operate the database for ATN Company, it needs pgAdmin management tool. ''pgAdmin 4'' is a client tool to connect and manage PostgreSQL Database and it is the most feature-rich platform for managing and developing PostgreQuery databases.

Figure 2 pgAdmin 4 (pgadmin, n.d.).

Github integration helps ATN developers to pull requests, push, commit, and work with every branch they want. Github is also integrated with HEROKU to build processes including build, test, deploy...

Figure 3 GitHub (Tom Preston-Werner, 2008).

Sublime text 3 is the editor tool of choice in assignment 1, for ATN developers to work and code effectively. However, after analyzing and evaluating which editor to choose, it's really difficult and according to (codecademy, 2018) introducing the most prominent editors that programmers often use: Sublime, Visual Studio Code. Then Visual Studio Code is more suitable for ATN developers to build and coding the web pages with the following the reason.

- Visual Studio Code is a powerful and flexible cross-platform editor, bringing a lot of benefits for ATN developers. With VS Code, managing extension packages is very easy. The interface is user-friendly, and the ability to prompt commands and report errors is excellent.
- One thing special about VS Code is the integration of Github, which is very convenient. For commits, diff it is almost perfect and the execution time is very fast ATN Company uses Github integrated with HEROKU to deploy the website they are building.

Figure 4 Visual Studio Code (Corporation, 2015).

The Programming language is PHP used to build Website of ATN Company. PHP can connect to databases like PortgreSQL and HEROKU supports deploying PHP applications on HEROKU.

Figure 5 PHP Programming language (Lerdorf, n.d.).

So ATN developers can easily and deploy their website based on Service requirement:

- Application platform: Heroku.
- Programming language: PHP, HTML.
- Database: PostgreSQL. pgAdmin4.
- Tools needed: GitHub, Visual Studio Code.
- Framework: Bootstrap.

2.2 Step by step instruction.

Below are pictures and explanations of the steps to connect and build a toy selling website for ATN Company based on Platform as a service (PaaS).

2.2.1 Visual Studio integration with Github.

In Figure 6 had showed the step to create repository. The first step in integrating visual studio code with GitHub is to create a repository. Then enter the name, description and local path for project. Step finally, click to the ‘’Create Repository’’ button.

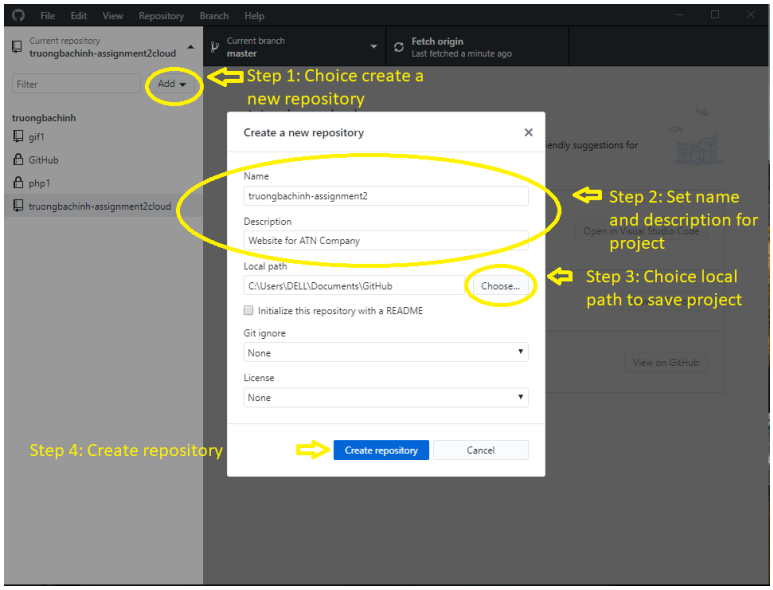


Figure 6 Create repository.

In Figure 7, after successfully creating the repository with mane "truongbachinh-assignment2cloud". The next step is Click to button `` Open in Visual Studio Code ''. Besides, developers can also change the editor by clicking on "Options".

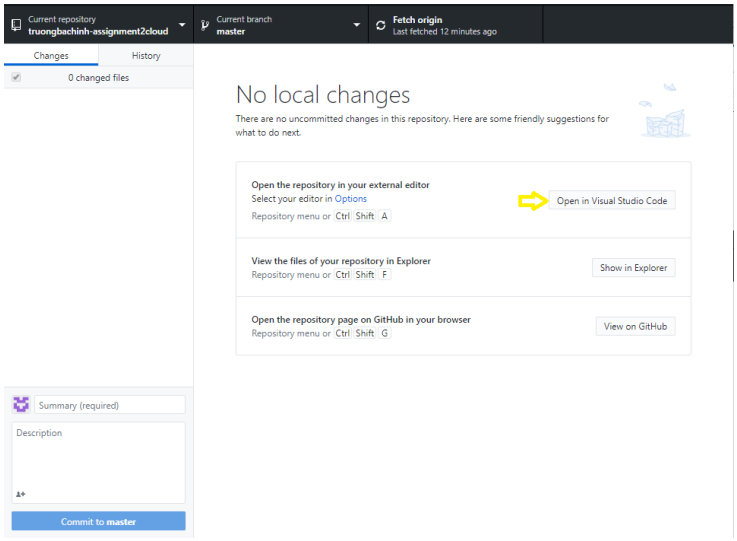


Figure 7 Open in Visual Studio Code.

In Figure 8, after clicking the ''Open in Visual Studio Code'' button the ''Studio Code edit'' will appear for developers to code to build a full-stack website for ATN's toy sale. The visual studio interface is really simple and easy to use.

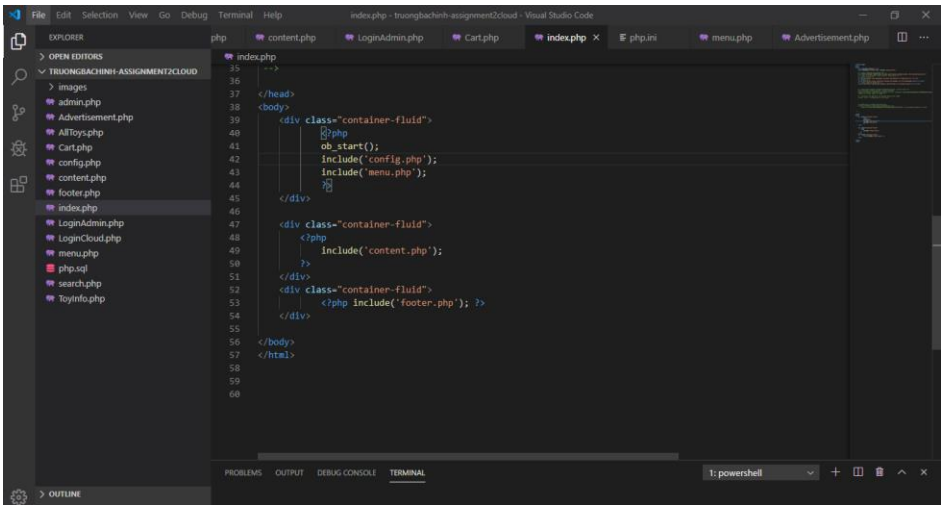


Figure 8 Visual Studio Code Editor.

In Figure 9, after VS is integrated with Git, the changes developer make in their files are marked differently in Github so the website developer for ATN Company knows exactly what is going on. And they can commit what has changed by clicking the ''Commit to master'' button.

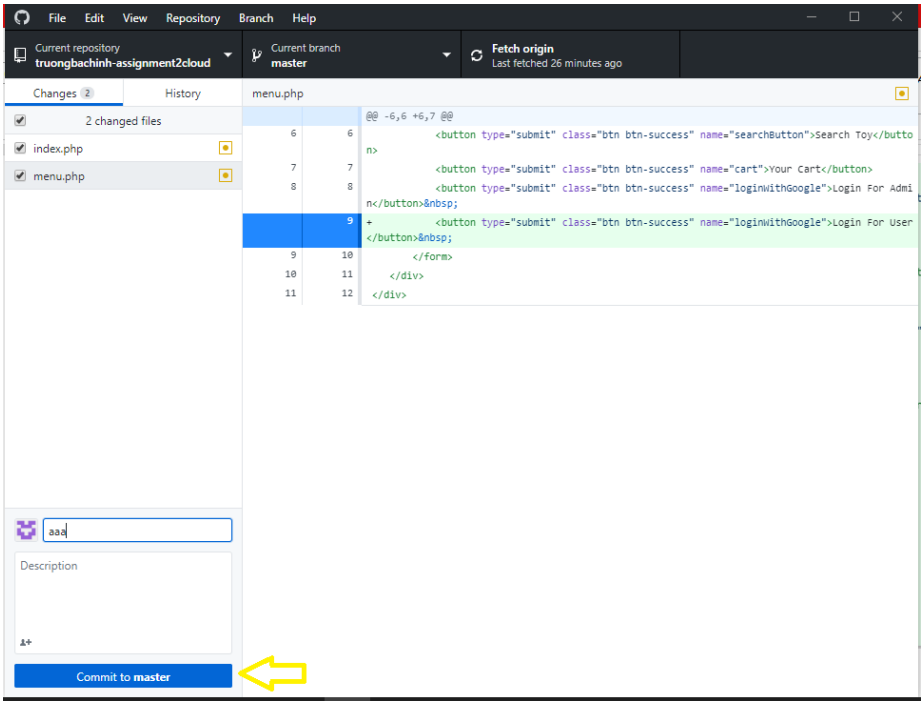


Figure 9 Commit to master.

In Figure 10, after the process of writing and making changes, the website developer for the ATN Company will click to the 'Push origin' button to complete the VS integration process with Git and push the code to Git's website. The developer can also open the repository page on Github in their browser by pressing ''Ctrl + Shift + G'' or by clicking the ''View on GitHub'' button as shown in Figure 10.

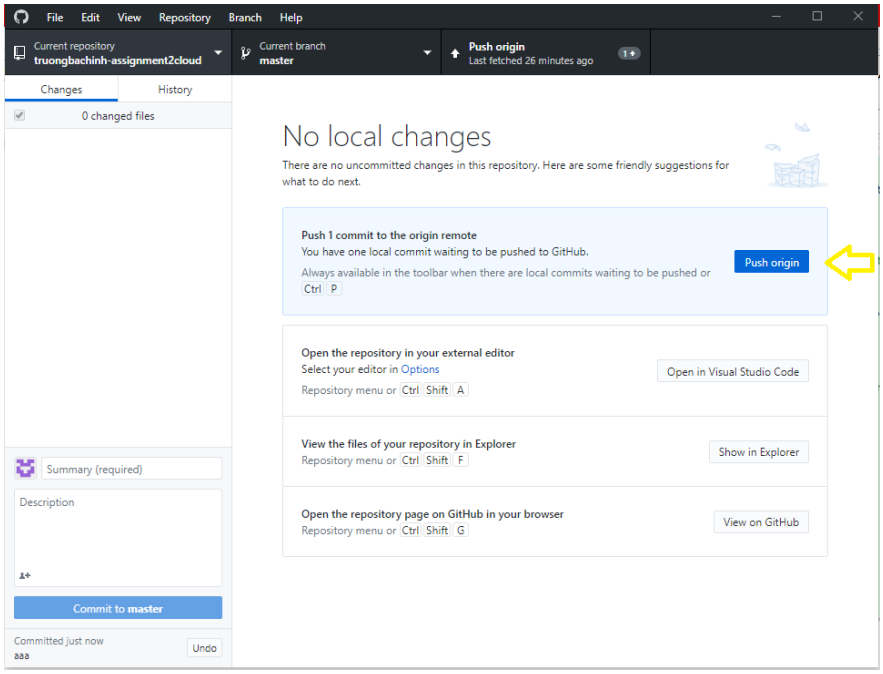


Figure 10 Push origin in GIT.

In Figure 11, the website will display the latest commit for developer and those granted access to view and edit the code online.

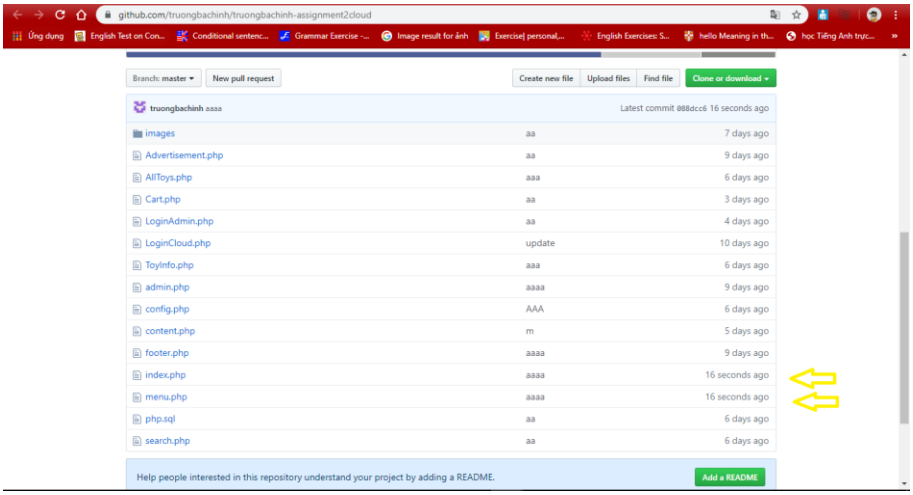
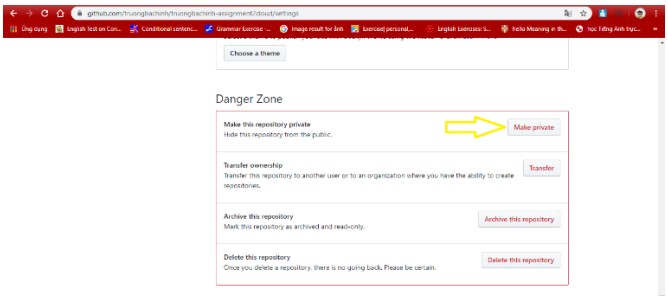


Figure 11 Git's website.

In Figure 12, to ensure the safety of the repository, developers of ATN Company need to make the repository in private state to avoid the intrusion and change of outsiders. Developers can click to ''settings'' then pull down the end to make private for repository. After changing the status of repository ''truongbachinh-assignment2cloud'' to private. Develop can invite to collaborate on the repository to follow the repository of ATN. As shown in Figure 12. I have invited ''Binh Do'' to join the repository ''truongbachinh-assignment2cloud''.



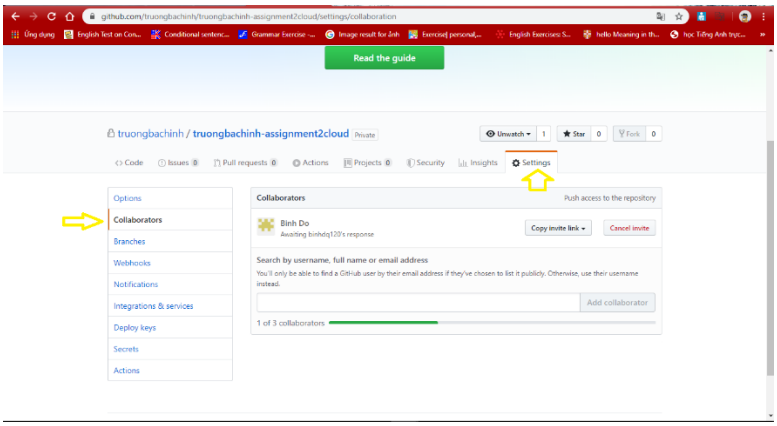


Figure 12 make repository private and invited to collaborate on the repository.

From Figure 6 to Figure 12, the process of integrating Visual Studio with Github of ATN's toy sale website with the name of the repository is ''truongbachinh-assignment2cloud''.

2.2.2 Using Heroku Platform.

In Figure 13, after visit linking https://id.heroku.com/login. The Heroku website will open a form that allows the developer or user to enter the account and password to access the Heroku dashboard. After filling out the correct account and password click the ''Sign In'' button. Without account, developers or users need to register by clicking on ''sign up''.

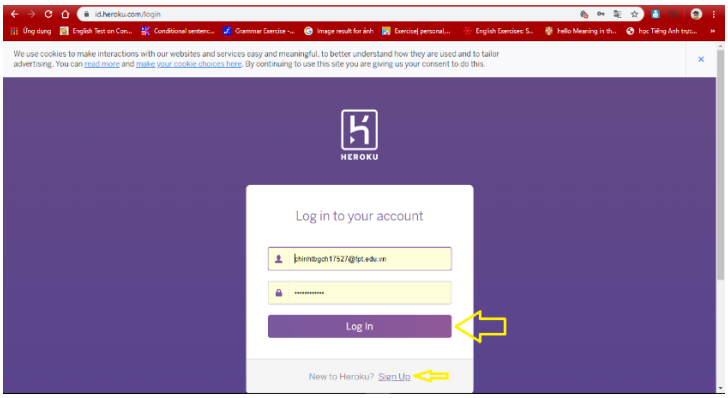


Figure 13 Login account to Heroku.

In Figure 14, Developer can click on '"New" combo box to create a new app. after click to '' Create new app " button the form will appear for developer fill name of app want to build. The name of app I set for ATN Company is “truongbachinh-assignment2cloud”.

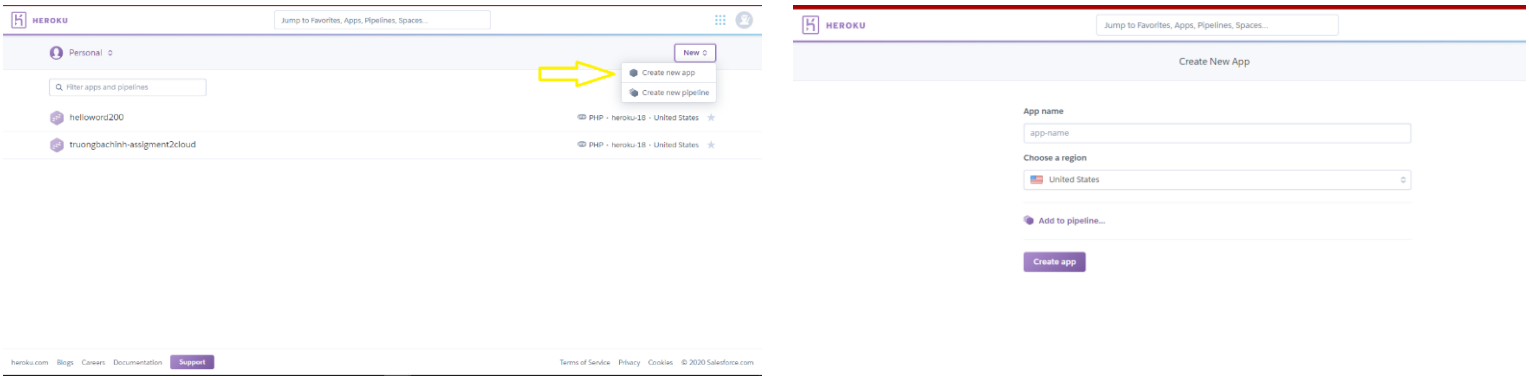


Figure 14 Create app in Heroku.

In Figure 15, after creating the application name successfully. The dashboard of HEROKU will appear and the deplorer will click on the project name ''truongbachinh-assignment2cloud'' to perform the integration and build app, including: Integration PostgreSQL, integrating Github with HEROKU and deploy the website selling toys of ATN.

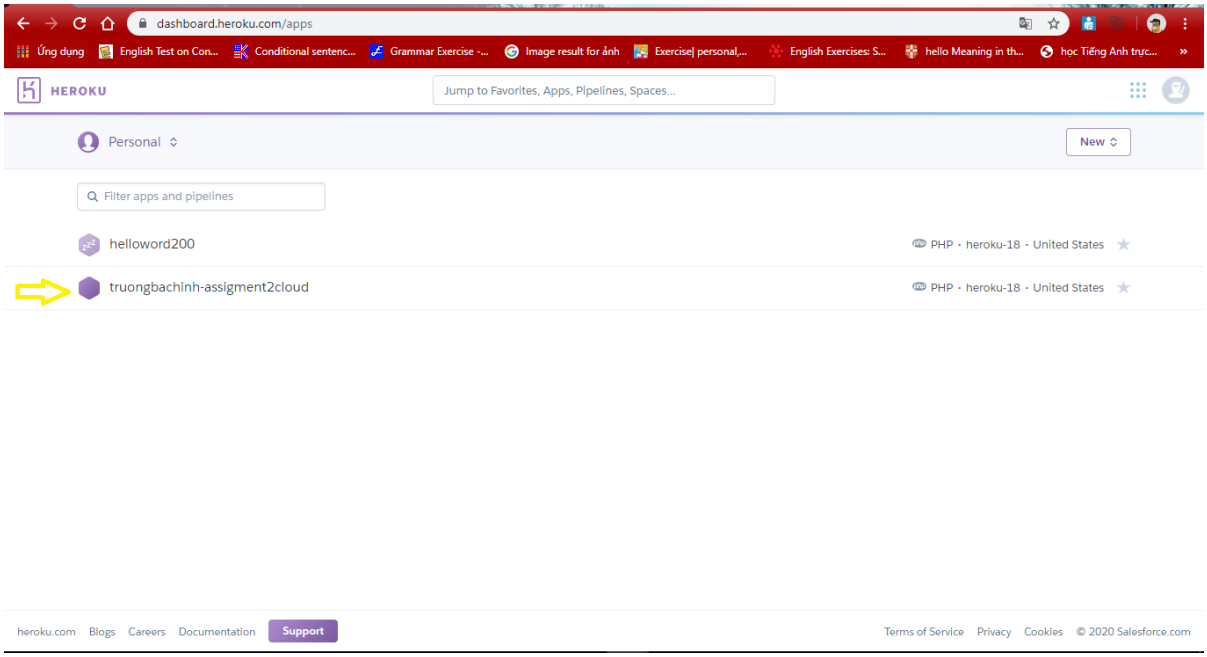


Figure 15 Dashboard Heroku.

2.2.4 Integrating Github with Heroku and deploy.

In Heroku website select deploy then enter the name of the repository '' truongbachinh-assignment2cloud '' name created inside Github then search and connect to github with Heroku as show in Figure 16.

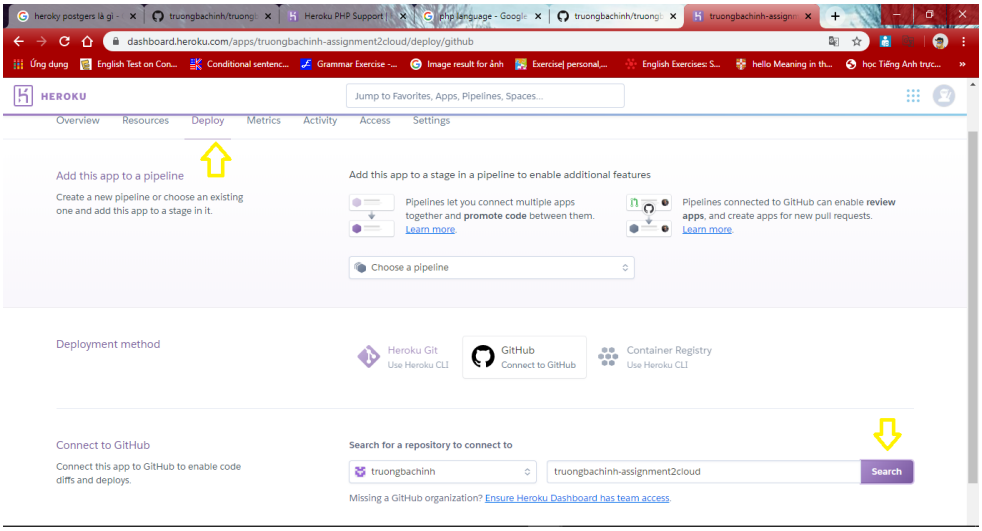


Figure 16 Integrating Github with Heroku.

Figure 17 shows the ATN Company's website deployment step by clicking Deploy Brach. It may take time during deployment. The developer can then view the website by clicking the view button.

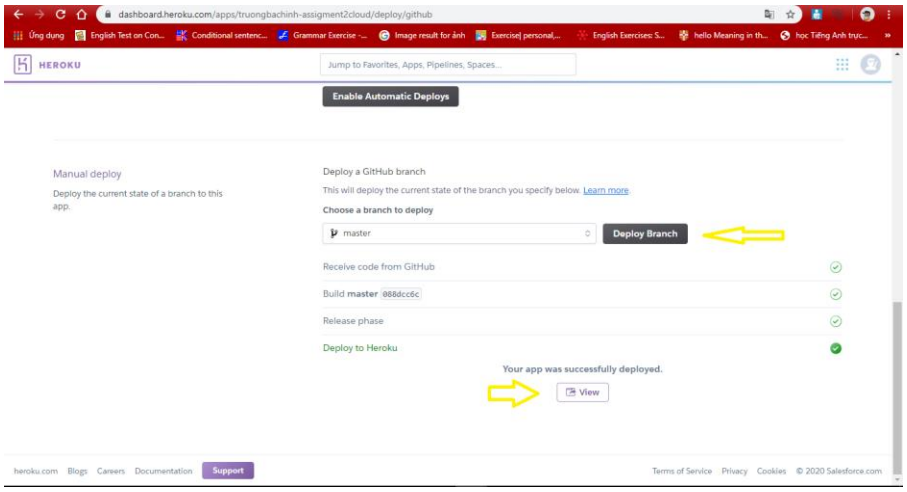
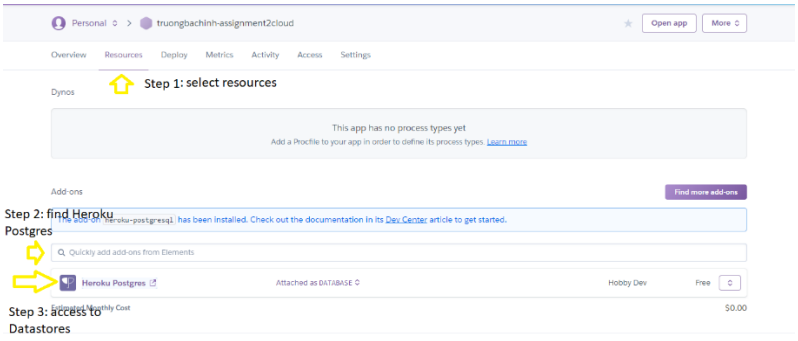


Figure 17 Deploy Branch.

2.2.3 Integration PostgreSQL with Heroku.

In Figure 18 show the process connect ''truongbachinh-assignment2cloud'' project wiht Heroku Postgres. After connect successful developer click like to step 3 to view data stores.



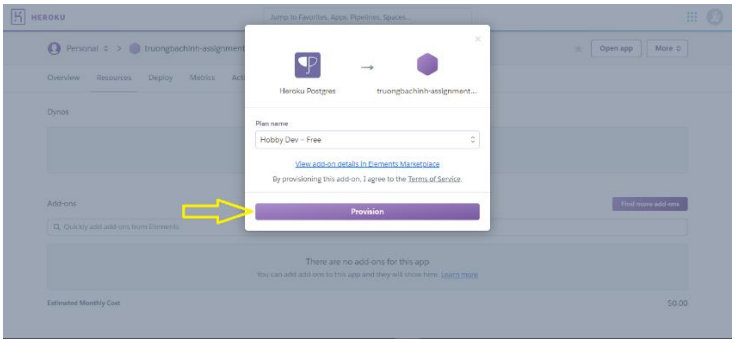


Figure 18 Connect Heroku Postgres.

In Figure 19, The Datastore of app appear. However to build database for website of ATN Company the developer need connect to pgAdmin to setup, create and insert data. Therefore, developer needs to follow the steps in Figure 17 to view credentials and use it to connect to pgAdmin 4.

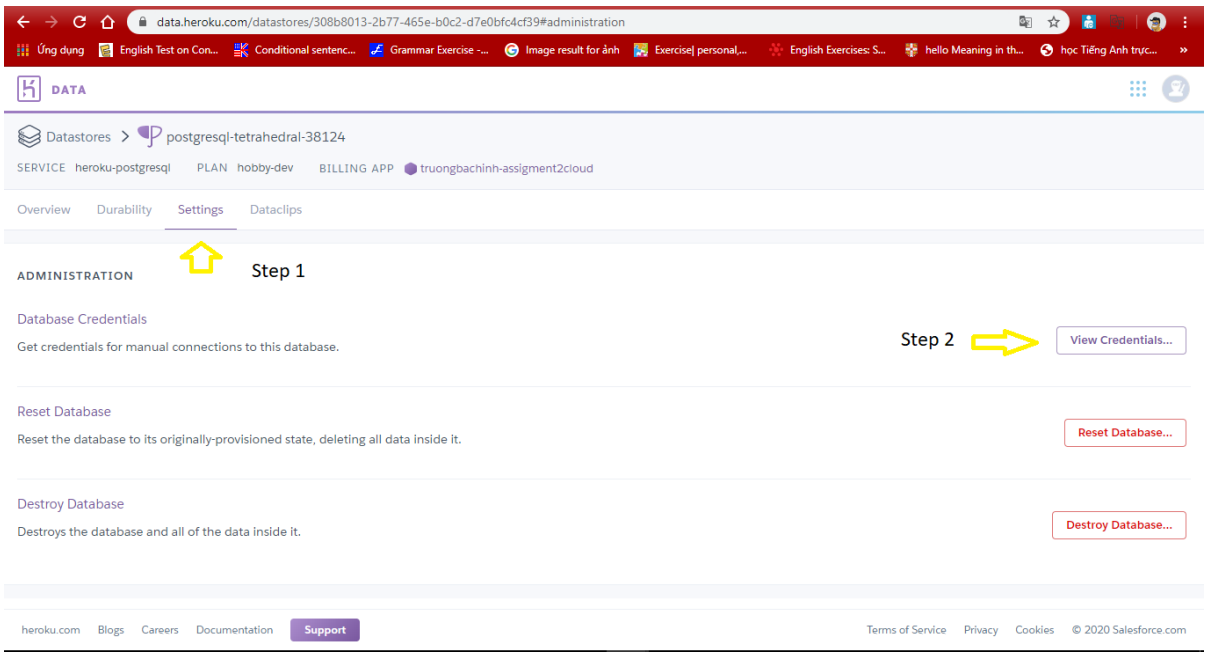


Figure 19 Step to view Credentials.

In Figure 20 shows the process of creating a server database for ATN company website with name of server-group is ''truongbachinh-assignment2-cloudcomputing'' and name of server database is ''databaseATNCompany''.

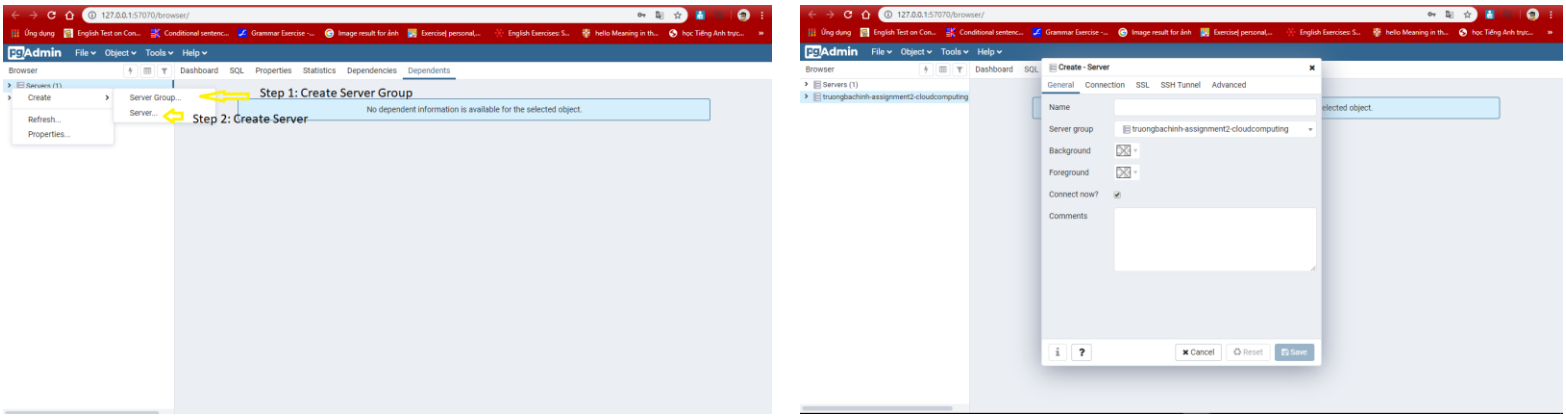


Figure 20 Create server database for ATN Company Website.

In Figure 21, Copy information from '' Database Credentials'' to form database of pgAdmin4 to connect together. Such as Host, Database, Username, Password… Then click to save button for Integration PostgreSQL with Heroku.

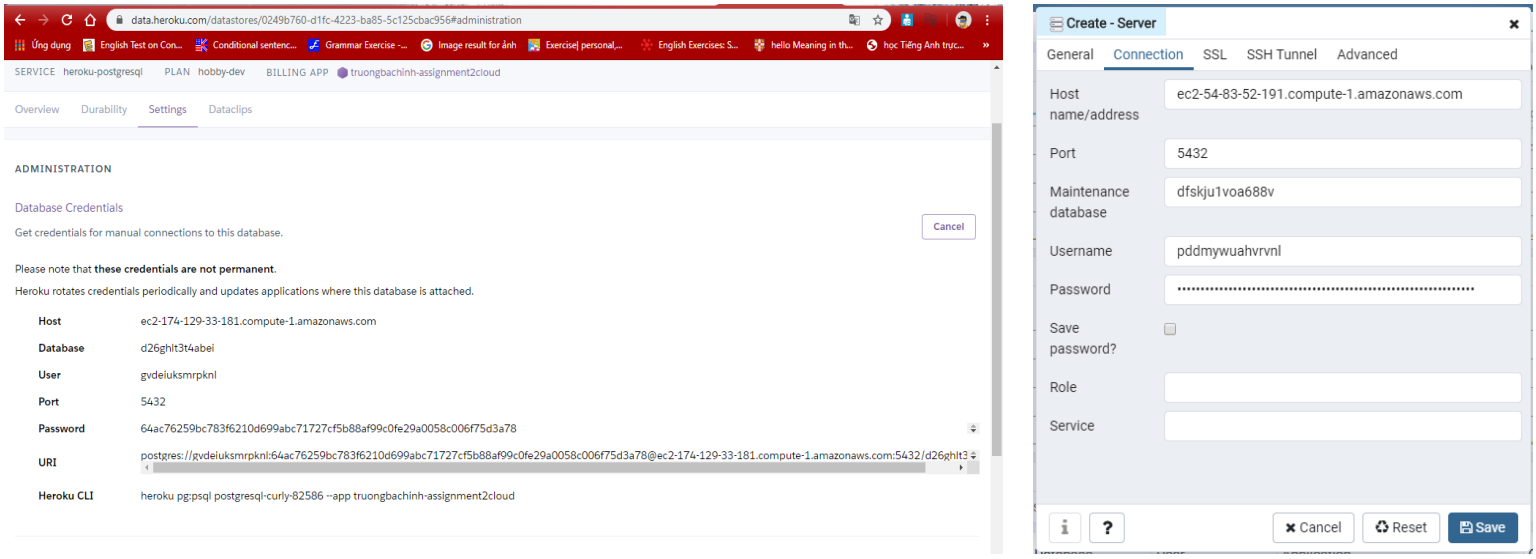


Figure 21 Integration PostgreSQL with Heroku.

In Figure 22, Developer select ''Query tool'' then create table for ATN company and Insert data. Finally, click to execute button or press the F5 key to build the database.

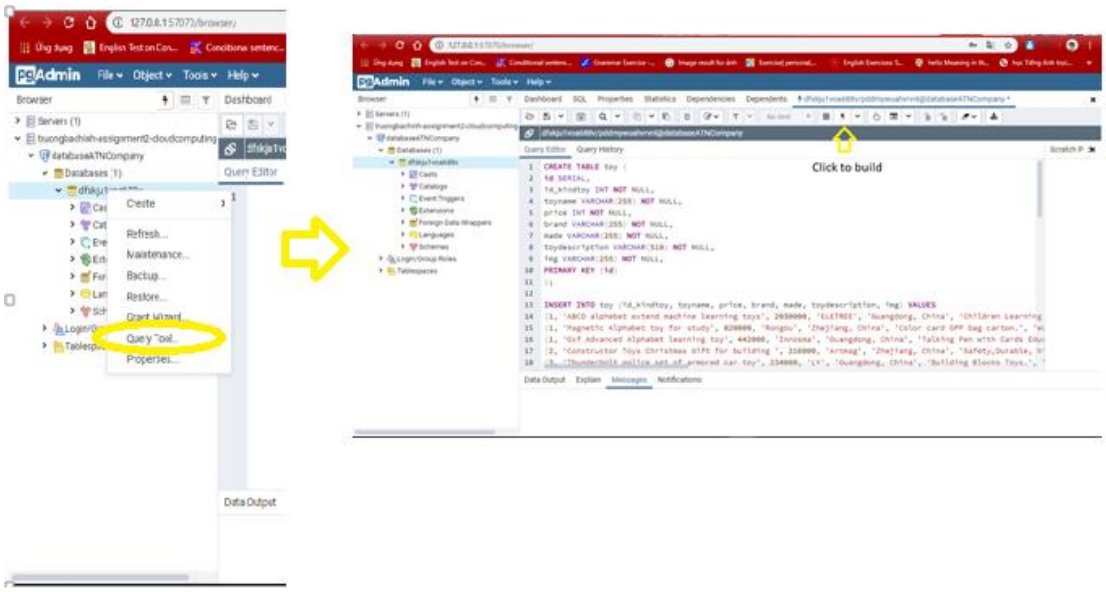


Figure 22 Create table and insert data.

In Figure 23 had showed the table of data after developer was created. In the pgAdmin developer write ''Select * from table'' to view database, Although, In Heroku developer view the database by click to Overview.

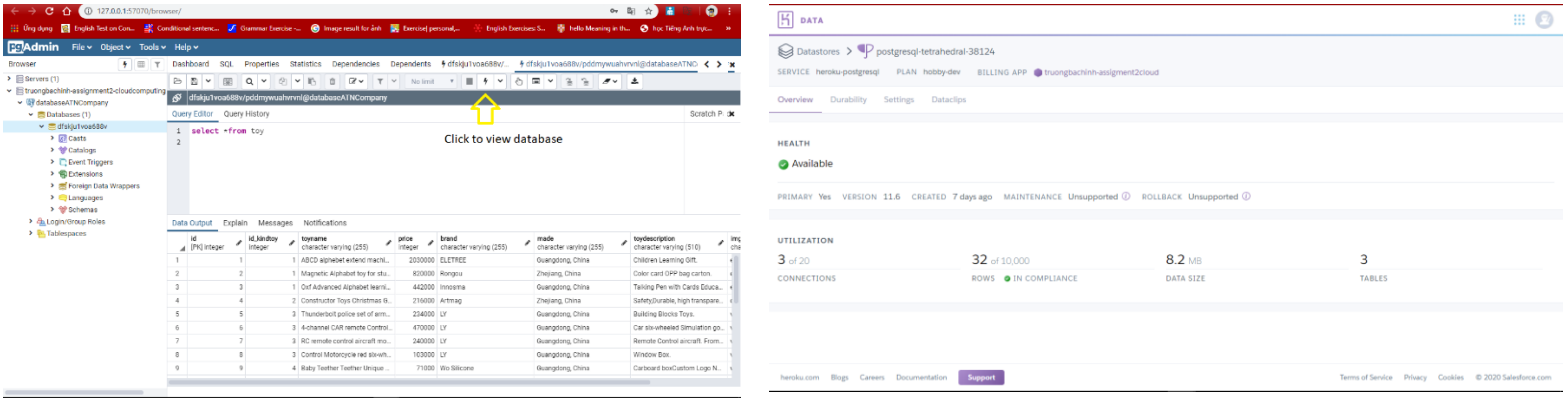


Figure 23 View data after created.

2.3 Website seller toy of ATN Company.

The website sells the company's toy after it has been completed. The Figure 24 show the index of website.

For customers can view the entire product of the company, can search for products by name or by category. Besides, they can add toys to their shopping carts.

For admin has the function of logging into the database system of the Website to add, delete and update data.

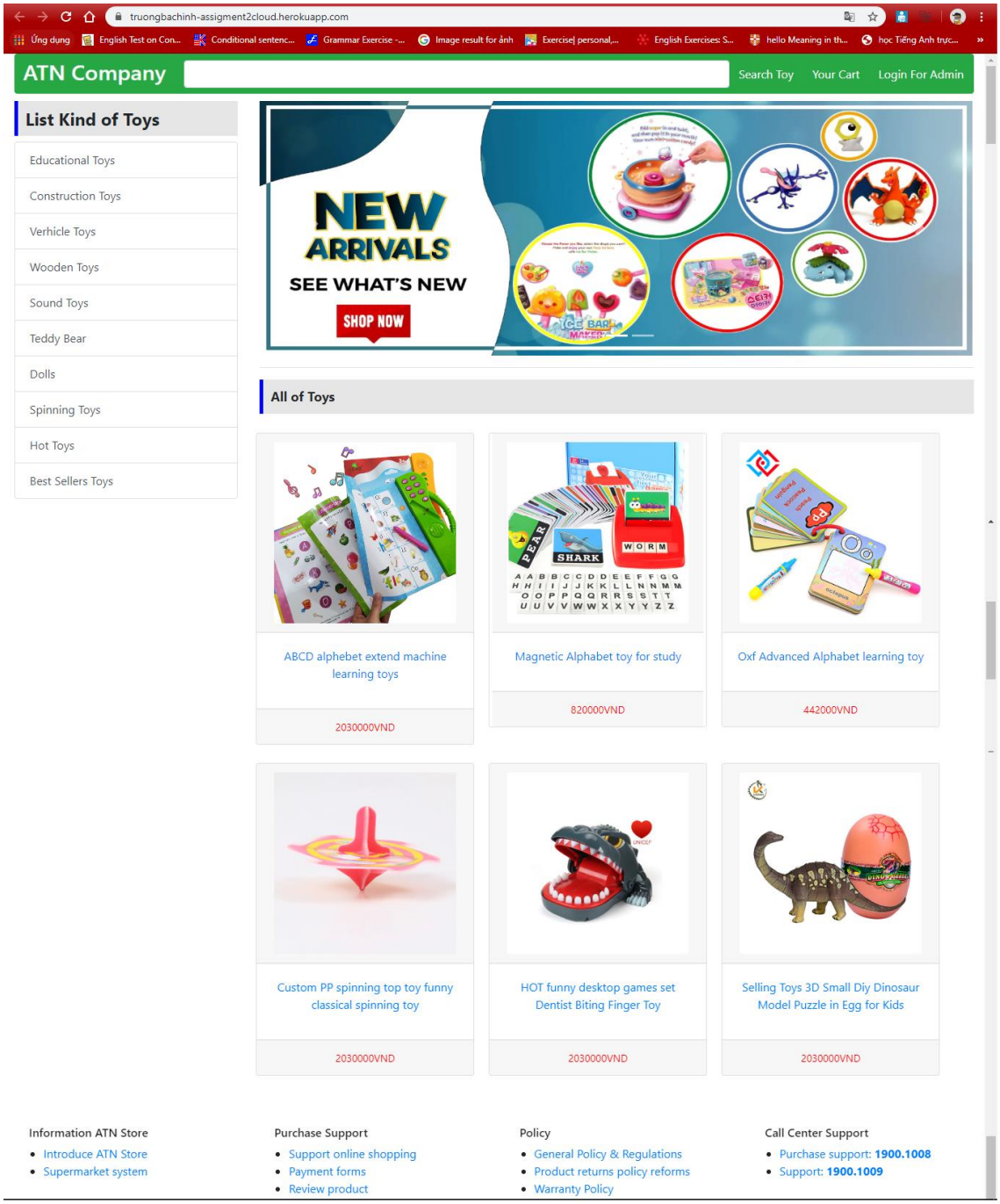


Figure 24 Index ATN Company website.

2.3.1 Search Function.

In Figure 25 shows a search by click to ''List Kind of Toys'' category. 10 types of toys have been created, including: Educational toys, construction toys, toy vehicles…

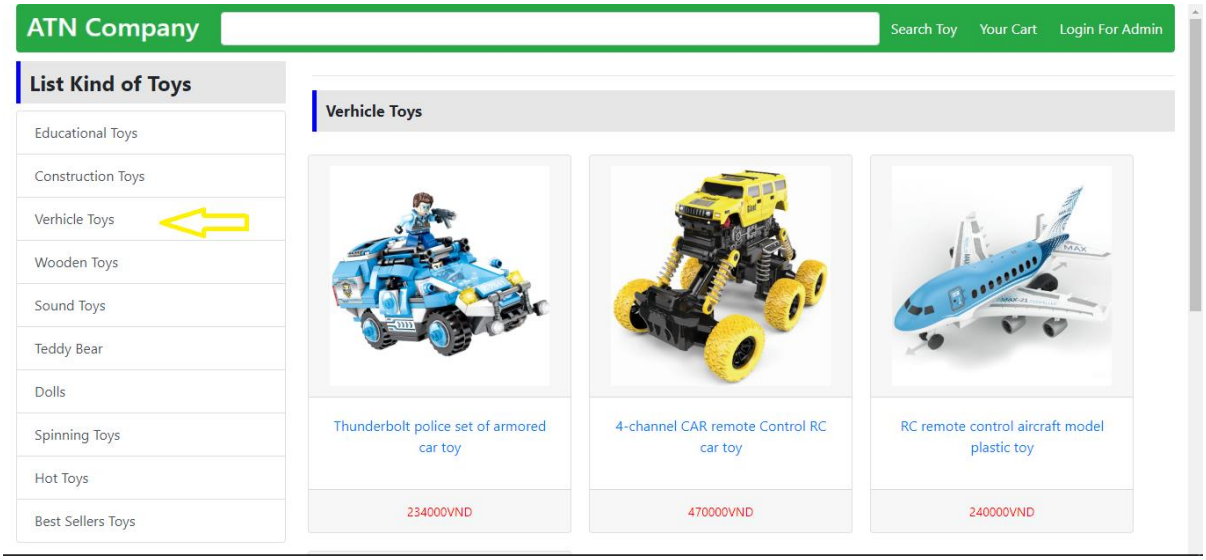


Figure 25 Search by category.

Figure 26 shows the search by name of the toy. Customers enter the name of the product they want to search and click on the Toy Search button to view.

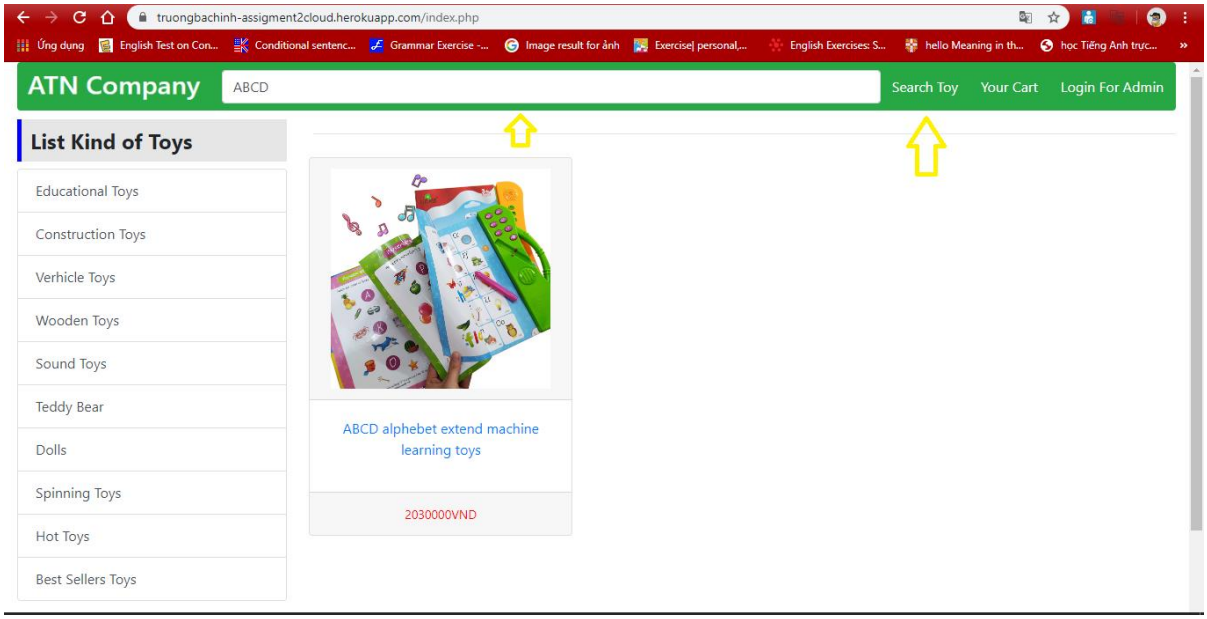


Figure 26 Search by name of toy.

After searching for the product. Users can click on the product image to see detailed information and price for that product. Perform as shown in Figure 27.

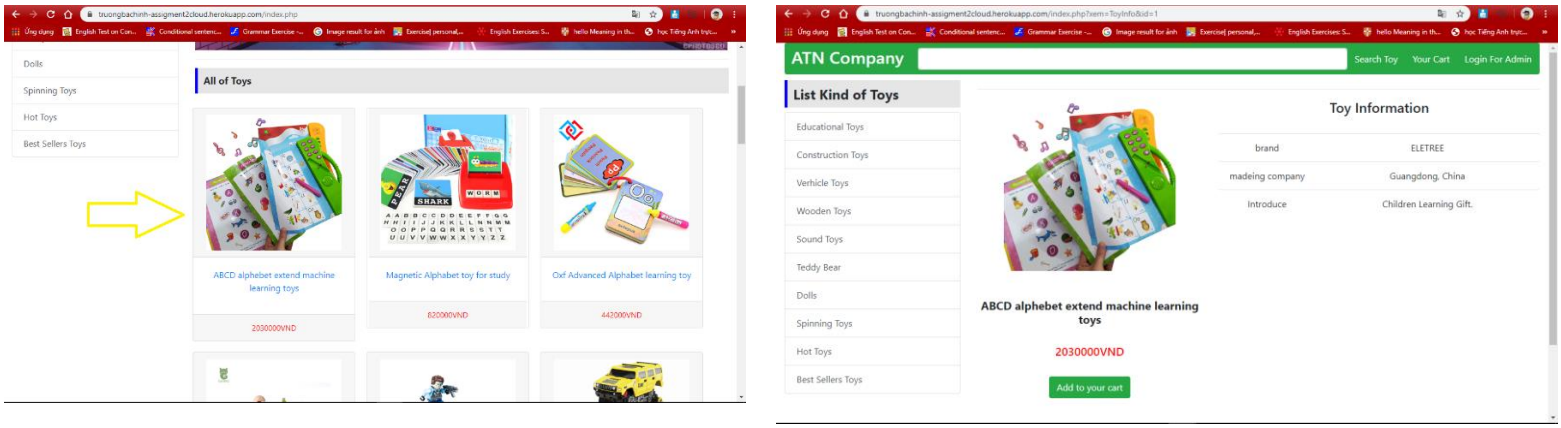


Figure 27 View information of Toy.

2.3.2 Your cart function.

Customers can also add to the toys they want by clicking ''Add to your cart'' button after clicking on toys to view information about them.

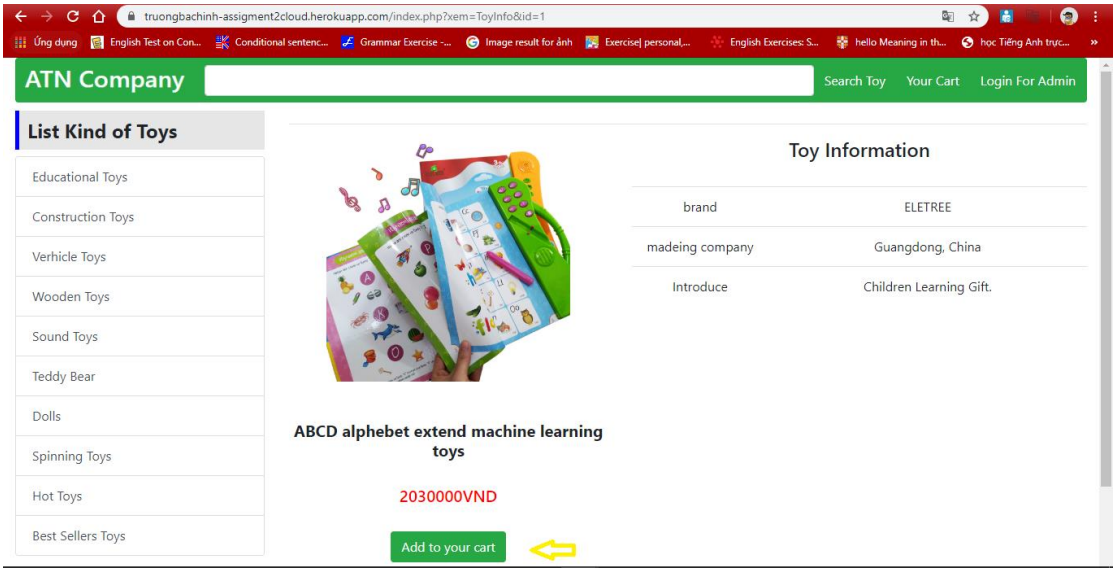


Figure 28 Add toy to Your Cart.

Customer can view the status of their product by click ‘’Your Cart’’ button. In the ‘’Your Cart’’ interface, users can continue shopping by clicking to `` Continue Buying '', Delete all toys to buy by clicking Cancel button. Order button build fail as showed in Figure 29.

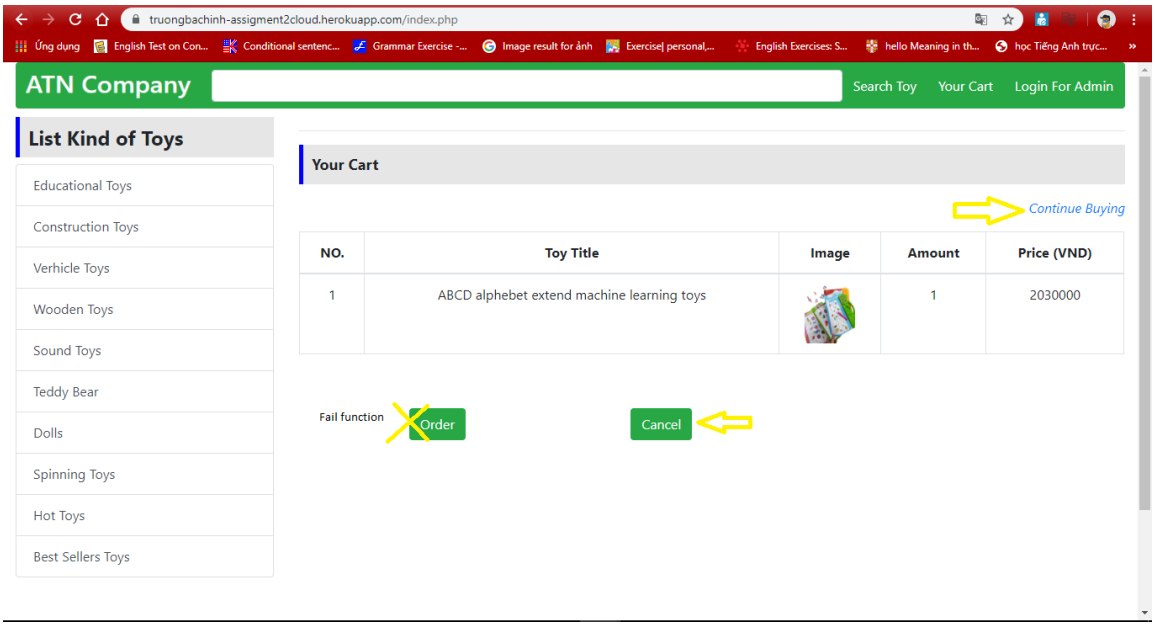
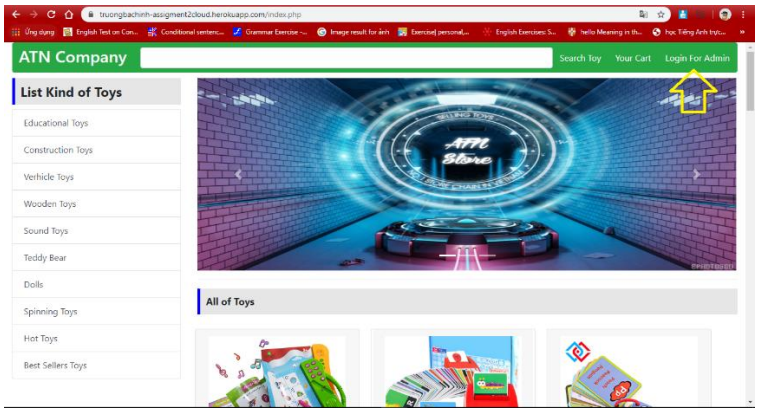


Figure 29 Your Cart.

2.3.3 Admin Function.

In Figure 30 shows the login process for the administrator. Firstly, administrator click to '' Login for Admin'' button to view login form for administrator. Then, admin enter username: ‘’chinhtb’’ and password: ‘’123456’’ to access database of website.



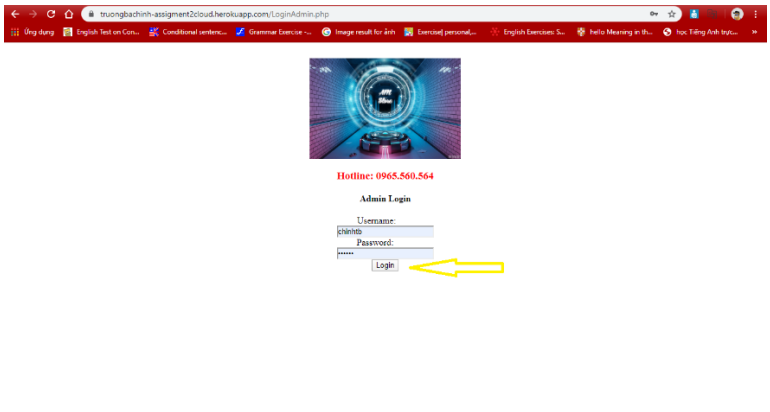


Figure 30 Login for admin.

In Figure 31 show the interface of admin function allow admin of ATN website add, delete and update toy.

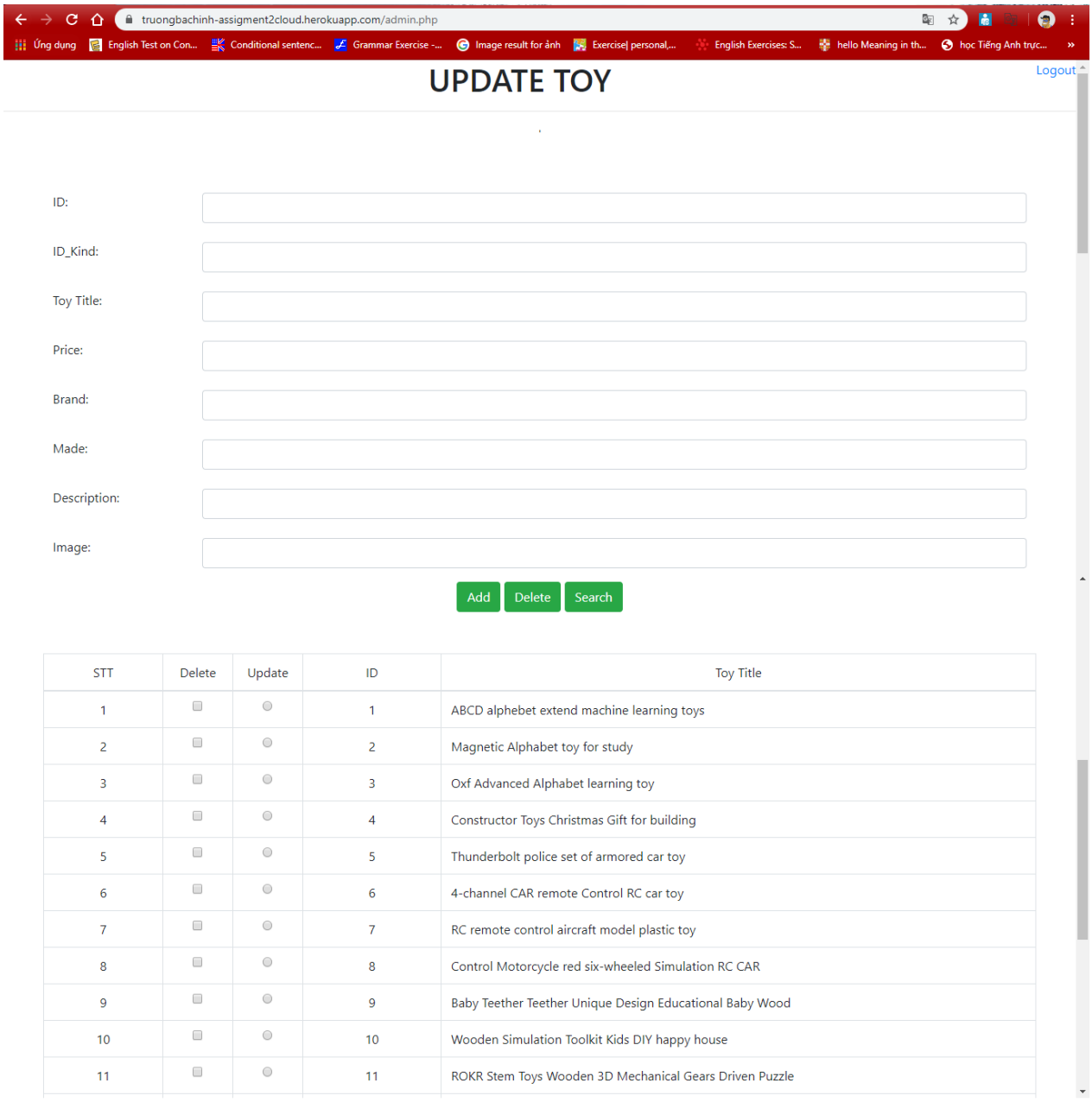


Figure 31 Interface of Admin Function.

In Figure 32, Administrators adds a new toy to the database of the ATN website. After filling in the data, Administrators click to ''Add '' button to adding new toy. One thing to note when adding new data is that the new id must not coincide with an existing id.

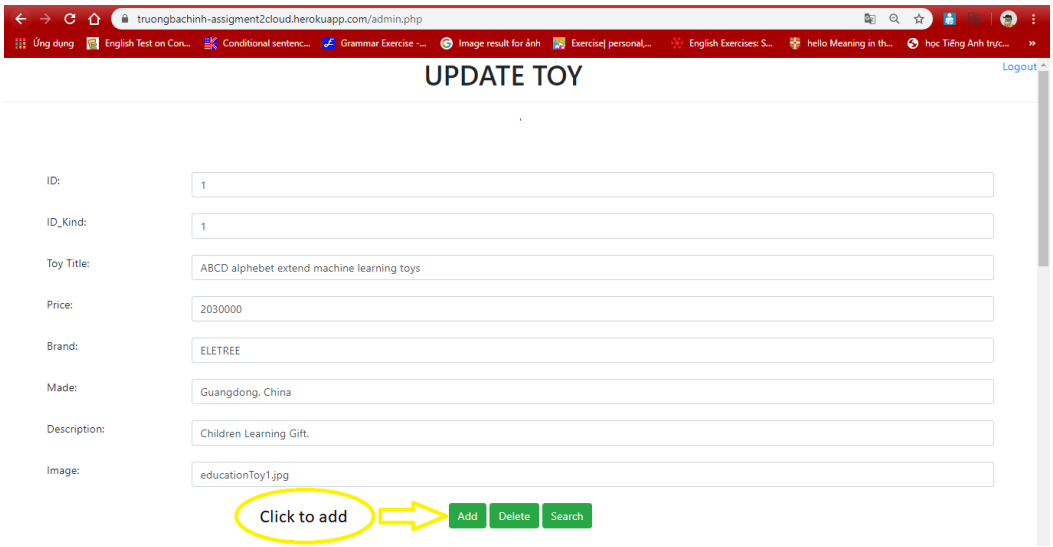


Figure 32 Add function.

In Figure 33, Administrators click the checkbox to select toys to delete. Administrators can delete multiple toys at once by selecting the checkboxes to delete. Then the administrator clicked on the ''Delete'' button to remove toys from the ATN Company database.

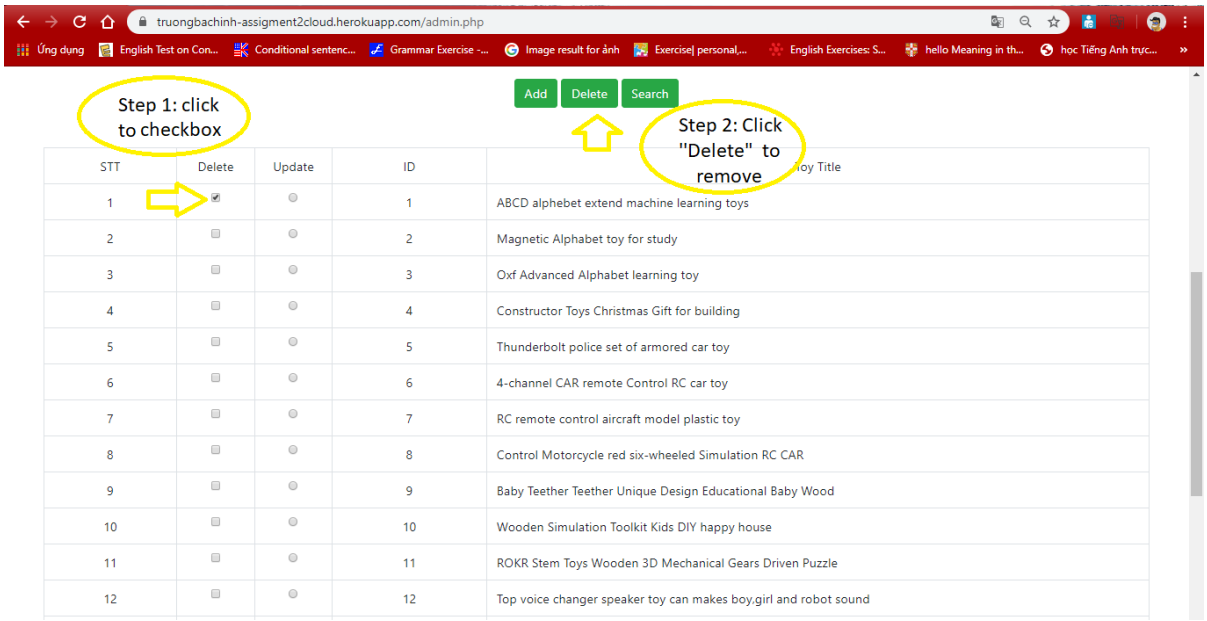


Figure 33 Delete Function.

In Figure 34, showed process update toy for ATN website. Administrators click to ''Update'' radio button to select the toy that needs updating, after the selection is complete, the information of toy will appear in the search box. Then, administrators can edit toy information and click the Add button to update the toy.

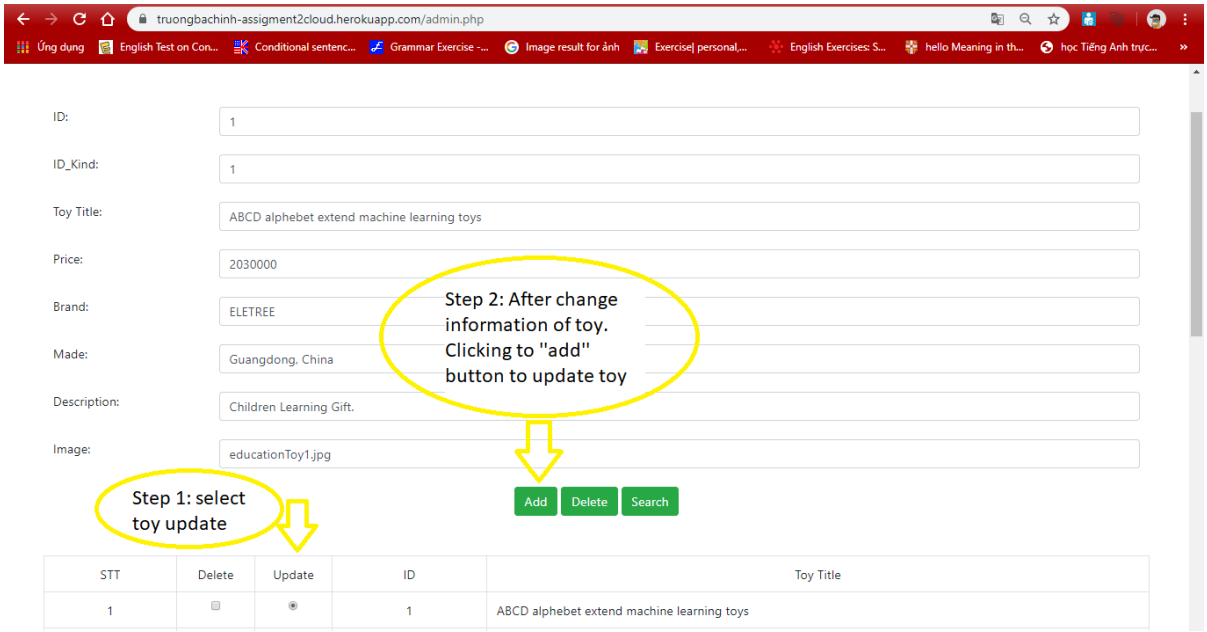


Figure 34 Update function.

2.4 Difficulties encountered in the development process.

During the process of deploying the ATN website, I encountered the following difficulties and solutions. Test Log and Fix bug.

1. Test Log and Fix bug.

- Difficulty: Building a website for ATN Company requires a lot of process of testing code errors and fixing bugs so that the website can run stably and minimize errors when using. However, deploying each test code needs to be implemented on Heroku which takes a lot of time. Follow these steps. After editing the code, you need to commit. Then push on Github, and finally deploy on Heroku to see how the website works. This takes a lot of time for developers to build websites.
- Solution: To save time, in the process of building a website for ATN Company. Developers conduct testing on Localhost. After completing the application on the local, we will deploy to Heroku to deploy the website. For example in ATN project: using XAMPP software is a fairly common software application and is often used by programmers to build and develop website projects in the PHP language. XAMPP is used for researching and developing websites through Localhost of personal

computers. So use XAMPP to develop code after completing the test log and Fix bug, then deploy to Heroku to deploy ATN website.

2. Database connection.

- Difficulty: In the process of integrating Heroku with PostgreSQL it was difficult when many computers used the same network to connect, it would not integrate Heroku with PostgreSQL. For example, there was a time when our class together integrated Heroku with PostgreSQL. We all use the same network provided by the school. Most people can't integrate request time out.
- Solution: Use personal network or 4G data of their smartphone to connect Heroku to PostgreSQL database. It will make connecting easier and faster than connecting to the same network.

3. Get Credentials.

- Difficulty: Integrating PostgreSQL to pgAdmin 4. Developers often copy and paster credentials for pgAdmin 4 connections to this database. Sometimes they cause a problem that is incorrect information due to extra space or a lack of copy of the PostgreSQL form credentials, resulting in data heterogeneity in integrate PostgreSQL to pgAdmin 4 and failed database construction.
- Solution: To ensure the full definition of constraints. Users should enter the check and check if the entered code matches or not by copying into the word to check and make sure that the number of characters matches the credentials.

4. Upload image.

- Difficulty: Retrieving product image data from google drive or google photo is difficult.
- Current solution: Download all product images of ATN website from google drive to folder ‘’images’’. Then In coding, create a link go to the image in the ‘’images’’ folder. So developer can update the images for the ATN website.
- Future solution: In the future we will hire a cloud storage system to store images of products for ATN. This make deploying and uploading large numbers of images easy without upgrading server memory.

3. Common problems of cloud computing and solutions for them.

There are four deployment models including: private, public, community and hybrid cloud. Each type has its own advantages and disadvantages to suit each different purpose. The developers who use them will also experience different problems during the installation and

use. The common problems of each model type are described below when applying to ATN Company (Rabia Latif, 2014).

3.1 Private cloud.

1. Cost.

- Problems: The cost to build private cloud is high. ATN Company that want to use the private cloud need to buy hardware to set up and maintain at a high cost to operate the private cloud stably.
- Solutions: Using ''Virtual Private Cloud''. The Virtual Private Cloud provider will bear the costs associated with the purchase, management, and maintenance of the infrastructure system. When ATN uses this infrastructure, all enterprise data information will not be shared with any other businesses on the private cloud. Virtual Private Cloud can be a good choice for mid-sized businesses like ATN Company.

2. Limited active area.

- Problems: Private clouds are only locally accessible and can be difficult to scale deployment globally. That's why when ATN wants to expand its stores, it will have difficulty backing up and transferring data. ATN needs more money to buy new hardware to meet the needs of the private cloud system.
- Solutions: Devise strategies and visions before deploying the private cloud system to ensure the reuse of the installed infrastructure when building new systems.

3. Limited scalability.

- Problems: Private cloud can only be scalable only within the capacity of internal storage resources. Therefore, when ATN Company updates more data of new products, it will be difficult.
- Solutions: Build quality infrastructure with good memory and capacity that can meet ATN's scalability and long-term operation.

Based on the financial situation of ATN, which has a turnover of $ 700,000, and the company has a lot of facilities and backing up and pushing data to the companies' physicists to see if the company is struggling. Therefore, deploying and using Private Cloud for ATN is not really reasonable (Chandrasekaran, 2014).

3.2 Public cloud.

1. Secure.

- Problems: Public clouds are less secure than private clouds. In this model, all data on the Cloud service, is protected and managed by that Cloud service provider. This

makes large companies that need high security feel insecure about their important data when using Cloud services. Specific security requirements cannot be met when using public clouds or legal requirements cannot be met by public clouds.

- Solutions: Ensure the full definition of the binding. Before signing a contract of use with a public cloud provider, there are clear legal obligations as well as binding damages if stolen or disclosed by the company from the provider. Therefore, ATN companies need to read the constraints carefully and ensure that the public cloud they want to use complies with the security requirements in the ATN Company and encapsulation the important information before pushing to public cloud.

2. Dependent.

- Problems: Companies or organizations when using the public cloud will not have the ownership of the rescue and manage them. Therefore, when any incidents occur from the service provider Public Cloud. Company like the ATN Company that uses the provider's public cloud service will also be implicated.
- Solutions: Companies like ATN Company that using the public cloud should to store documents or information that is important to the company in their computer or physical. This makes it possible for the company to backup data when there is a problem with the company's public cloud system.

3. Performance and network.

- Problems: The performance of the public cloud model is largely dependent on the network and resources, so crutches play a major role in the public cloud. Accessing data in public cloud when the network is down or when the number of users is increasing, the service providers provide good performance is a challenging task.
- Solutions: Instead of upgrading the bandwidth and network quality. The Companies like ATN Company or provider that use public clouds and providers should use ''load balancing'' between the main route and the sub-network to distribute resources equally between two or more servers with the same functionality in same system. This will help and ensure the use of public cloud is stable. Or when the server goes down, Load Balancing directs the distribution of that server to the rest of the servers, pushing the system uptime to the utmost and improving overall productivity.

Base on scenario of ATN Company that ATN is a toy company in many provinces throughout Vietnam. The company has a turnover of more than 700,000 dollars / year. Currently each store has its own database to store transactions for that store only and they have difficulty in sending data from the store to the director and management users. Therefore, applying public cloud to ATN is justified following the benefits of public cloud

are suitable with the economic potential and needs of ATN. And ATN Company also has the ability to solve above public cloud problems (Chandrasekaran, 2014).

3.3 Community cloud.

1. Secure.

- Problems: Companies and organizations that use communication cloud are likely data can be leaked from one organization to another because community organizations use it to gain access and use the cloud.
- Solutions: Making a strong commitment to data security between companies or organizations that participate in the cloud communication.

2. Multitenancy.

- Problems: Community public needs to run multitasking due to having to serve multiple organizations at the same time so when the access between organizations in the public community is not equal, it will lead to conflicts between organizations.
- Solutions: Communication service providers and organizations, users need to use a network with a stable connection when accessing the system. And the publisher needs a load balancing to serve a large number of customers visiting at the same time.

3. Cooperation.

- Problems: Community clouds need the cooperation of companies or organizations if companies or organizations do not really cooperate with each other, it will be very difficult to use community cloud.
- Solutions: Getting to know partners before cooperating. Establishing compliance obligations when using between cloud community organizations to operate on a stable system (Chandrasekaran, 2014).

3.4 Hybrid cloud.

1. Complex cloud management and operating.

- Problems: Hybrid cloud management is complex and a difficult task because the hybrid cloud involves more than one type of deployment model and the number of users is very high.
- Solutions: In Company, building a strong IT support team can solve problems in using hybrid cloud.

2. Service Level Agreement (SLA).

- Problems: Hybrid cloud as both private and public cloud are involved. Therefore, the SLA is one of the important aspects of hybrid cloud by SLA of private cloud without

strict agreements, while the public cloud has certain strict rules mentioned. Therefore, it is difficult to establish an SLA between a customer and a service provider when using hybrid cloud.

- Solutions: Providers should clearly set SLA specific details about services provided to consumers, time standards for each level of service. Conditions for the service to be best available to ensure that there is no conflict between the user and the provider (Chandrasekaran, 2014).

4. Security risks and cloud security mechanisms in cloud computing.

Security concerns in the cloud are not different from other services. Cloud security consists of a set of policies, controls, processes, and technologies that work together to protect cloud-based systems, data and infrastructure. From authenticating access to traffic filtering, cloud security can be configured according to the exact needs of companies or organizations, and of course when a company hires and uses the cloud system it needs must understand the types of problems and risks of cloud computing to avoid encountering attacks or risks during use.

Security plays an important role in the cloud computing environment. In session 4 will focus on various issues of cloud computing security and cloud security mechanisms. Including: data security, virtualization security, organizational security, compliance and audit security, technological security and physical security. Besides, ATN uses PaaS so the security issues in the models (PaaS) are also raised so that ATN Company understands the importance of security in PaaS in particular and cloud computing in general.

The following five types of risks and how to deal with them are given with examples for them to understand. Below are considerations of the 5 basic types of cloud security risks of cloud service providers (CSP) and cloud service consumers (CSC) (Rabia Latif, 2014).

4.1 Risks from Cloud Providers Perspective and Solution for them (CSP).

In Figure 35 (Rabia Latif, 2014), the five main areas of interest of cloud providers when it comes to security.

Figure 35 Cloud Providers Risk. (Rabia Latif, 2014)

4.1.1 Data security (CSP).

1. Data Security, Privacy & Control Risks.

- Problem: CSP is responsible for data security while being processed, transferred and stored so they ensure the integrity and privacy of data against attacks or vulnerabilities of cloud computing systems. For example: Photo stored on cloud has been edited, collage.
- Solution: Ensuring data integrity, privacy, and availability, CSP is responsible for applying additional security measures to ensure data safety by providing data encryption and backup schemes scheduled.

2. Identity and Access Management (IAM).

- Problem: In cloud computing administrative access is done via the internet and this increases the risk of unauthorized access to data and resources of the bad guys, the thief will take advantage of the vulnerabilities from the internet to access left. Access to data and resources.
- Solution: avoiding unauthorized access, CSP should provide strict access control mechanisms. The solution is to encrypt the data in a different way and only disclose the corresponding decryption keys to authorized users. For example: Only provide the key to the person directly responsible and authorized for the encrypted data.

3. Confidentiality.

- Problem: CSP needs to ensure that CSC data is not disclosed to any unauthorized party, but CSP does not have access to the physical security system of the data centers to get full data security. Instead they have to depend on the infrastructure provider. Which is a big security risk for CSP. For example: people with authority and functions on data protection give CSC new access to data.
- Solution: To ensure that data belonging to CSC is not disclosed to any unauthorized party. CSP needs to comply with clear commitments and obligations regarding the

confidentiality of CSP and infrastructure providers. If one of the two parties causes the data of CSC to be leaked, it will be legally responsible (Rabia Latif, 2014).

4.1.2 Organizational (CSP).

Organizational risk is classified as the risk that may affect the structure of the organization or business in use.

1. Business reputation.

- Problem: Loss of business reputation. If a CSP is deactivated, bankrupt or acquired by another entity, this will negatively affect both CSP and its users.
- Solution: Choose more suppliers, don't let the solution and basis of the company's operating platform depend too much on the supplier. Choose suppliers with good capacity, high finance, and possible bankruptcy and low legal issues.

2. Organizational Change management.

- Problem: management changes due to the organization's politics, changes to everyone's work are a great risk of the organization For example: Huawei company will not be able to use the Google services previously provided, forcing them to use it on other platforms. The lack of Google services not only makes it difficult for Huawei to do business but also makes it difficult for Huawei to operate and update data for Huawei users
- Solution: Clearly identify organizational change issues from the start of operations and use insights from organizational change management and relevant key stakeholders in the application process. Such as signing compensation agreements if the contract is broken

3. Malicious insiders.

- Problem: people in the organization can cause harm by using data provided by their CSC and exchanging and trading data with bad guys.
- Solution: There is a need to reassess existing security models and develop security standards to ensure the deployment and adoption of secure clouds to prevent insiders from taking advantage of holes to steal data. For example: Do not allow employees to bring personal laptops to work and access company data, Do not allow employees in the company to turn on the workplace cameras. Do not allow outsiders to connect to the company's network to ensure data security (Rabia Latif, 2014).

4.1.3 Technological (CSP).

Technical risks are defined as errors related to technologies and services provided by CSP such as hardware, technology of CSP. Including: the mobility and interoperability of CSP-provided service systems, hardware-related technical risks including poor hardware maintenance and resource sharing isolation issues.

1. Portability in the Cloud.

- Problem: the incompatibility between CSP platforms leads to less interoperability between the clusters.
- Solution: The solution is to use the hybrid cloud, which is capable of handling much of these compatibility issues or using cloud mediation software to easily interact with the cloud or cloud integration for example: Connecting IBM applications - allowing administrators to set up workflows that determine how to move data from one application to another easily.

2. Application Development.

- Problem: CSP downtime, no service, or data loss will affect and disrupt active applications
- Solution: Apps developed on cloud computing platforms should use multiple cloud providers and monitor applications from outside the cloud to ensure that their applications are working. For example: using parallel service providers like drop box and google drive.

3. Lack of Interoperability Standards.

- Problem: Cloud computing is faced with the problem that there is no common standard for data export and communication formats between and in CSP, which makes it difficult to build security frameworks for CSP.
- Solution: Apply worldwide standards to CSP's service system. For example: Applying the IEEE Standards Association (IEEE-SA) (Rabia Latif, 2014).

4.1.4 Compliance and audit (CSP).

These are risks related to the law. Risks associated with the lack of authority information or illegal terms in contracts and ongoing legal disputes. CSP is subject to external audit and security certification. If a CSP does not comply with these security audits, it will lead to a marked decrease in customer trust.

1. Legal challenge.

- Problem: Violation of the terms of the law does not allow for example: outsourcing server to make bad websites, legal trading, football betting, legal issues.

- Solution: Propagating and warning the penalties for engaging in illegal activity in the law can be severely charged. For example: CSP must abide by all the regulations within a country, regarding cloud security. These regulations include HIPPA, FISMA.

2. Business continuity and disaster recovery.

- Problem: Natural disasters affecting systems such as earthquakes, storms, tsunamis. Or human-caused disasters such as fire, electric shock.
- Solution: CSP should have a security policy with recovery methods in the event of a disaster and the ability to recover data completely in a pre-set time period. For example: building data backup facilities in places far from each other to ensure the data is always safe and equipped with fire protection equipment (Rabia Latif, 2014).

4.1.5 Physical security (CSP).

1. Data Location.

- Problem: An attacker can steal the entire server, even if they are protected by firewalls and encryption.
- Solution: CSP should deploy and operate appropriate infrastructure controls including staff training, physical location security, and network firewalls closely to avoid attacks or theft of bad guys. For example: using surveillance cameras 24/24 where the area containing the hardware, infrastructure of data.

2. Server, Storage and Network.

- Problem: Servers, storage and networks are considered a challenge for CSP, which is the issue that CSP needs to ensure safe operation to provide a safe, secure location for customer data on times.
- Solution: CSP needs to comply with the privacy regulations of those jurisdictions and establish backup systems to ensure that data during operation is not interrupted. For example: Use 2 different network providers like VIETTEL and FPT to run the system. When a broken network provider still has a backup network to operate (Rabia Latif, 2014).

4.2 Risks from Cloud Service Consumers and solution for them (CSC).

In figure 36 (Rabia Latif, 2014) , the security challenges that typical CSC faces will be described in detail below and the solutions for them.

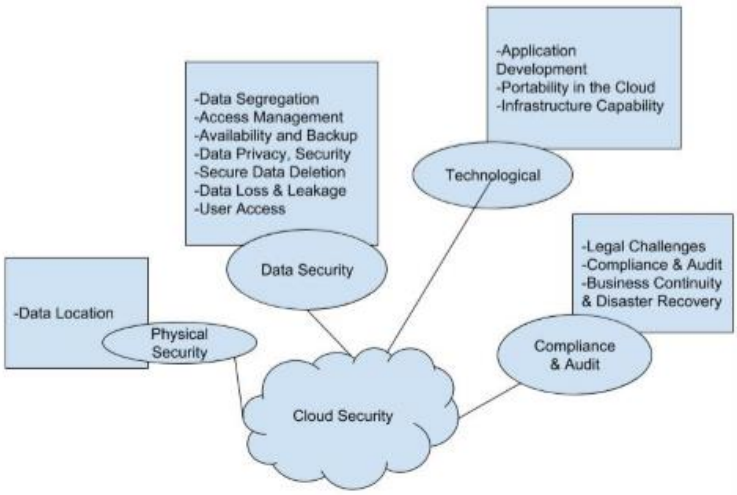


Figure 36 Cloud Customer Risk (Rabia Latif, 2014).

4.2.1 Data security (CSC).

Customers are responsible for the security and integrity of their own data even when pushed to the cloud of the provider.

1. User access.

- Problem: CSC is solely responsible for managing all software security controls, but the risk is that CSC depends on CSP's privilege of security such as error elimination, data corruption and data movement. Whether. For example, hackers take advantage of a Google drive vulnerability to steal customers' data.
- Solution: CSC establishes security policy including application access control, IAM, software patch, anti-virus to control user access.

2. Data Privacy and Security.

- Problem: The lack of cryptographic management information will result in sensitive damage to data loss and unexpected user data leakage to the outside world. For example: If a customer encrypts data before placing it in the cloud and loses the encryption key, the data will also likely to be lost.
- Solution: The key to decode needs to be built and based on specific algorithms and the cryptographers of company know to avoid forgetting or error.

3. Data Availability.

- Problem: When the customer pushes their original data into the cloud without retaining the original in local memory. Data and customer information in the cloud are not available or lost, it will be difficult to get back to the original data without the original file.

- Solution: Do not completely delete the original data, important and confidential documents of the company in the local memory of the company so that they can be recovered or backup when necessary (Rabia Latif, 2014).

4.2.2 Technological (CSC).

1. Infrastructure Capabilities.

- Problem: Technology conflict between CSC and CSP patch. For example: CSP's cloud performance may not match the agreed SLA due to server workload and network variability.
- Solution: Use other CSPs to be able to operate stably.

2. Portability.

- Problem: The hosting services provided by one CSP may not be compatible with the service of another provider. For example: customers who want to move from cloud service provider to other providers will make it difficult to backup and ensure the mobility of data.
- Solution: Using vendors that have interoperable platforms such as ATN's website uses Heroku to deploy in combination with Postgres and Github.

4.2.3 Compliance and audit (CSC).

1. Disaster Recovery.

- Problem: Cloud disaster customer data disaster will also be affected.
- Solution: Disaster is undesirable for CSC and CSP so the solution of CSC is to ask if the provider can completely restore your data and how long it will take to know the next processing wing.

2. Legal Challenges.

- Problem: Customer using cloud services with computing power or storage power can be located in many countries. It increases legal issues by exporting customer data abroad.
- Solution: Request CSP Make clear commitments to the retention and processing of customer data in specific jurisdictions providing the security and privacy of data as promised in the SLA.

4.2.4 Physical security (CSC).

1. Data Location.

- Problem: The location information of CSP data storage locations is not disclosed to customers. CSP providers store redundant data in multiple physical locations to ensure data safety.

- Solution: Customers cannot avoid cloud downtime, so the solution for customers will need to comply with the commitments in SLA and ask CSP to ensure that their data is always safe in every situation case (Rabia Latif, 2014).

5. Methods to ensure Data security.

5.1 Authentication in the Cloud.

There are several solutions that grant access to the cloud such as:

- Authentic by 2 factors: After users enter the correct password to access data on the cloud. Cloud system will send a verification code to request the user to enter the password twice to ensure data safety.
- Prevent editor from changing access and add new people: this case is used if you want the person you share to edit to not change access or add access to data on the cloud of the company system.
- Disable options to download, print and copy for commenter and reviewers: This case is used when the person or company that shares the right to comment or view data cannot download or copy the data (Rabia Latif, 2014).

5. 2 Encryption techniques in the cloud.

Encryption is closely related to the math and the power of computers. There are many different types of encryption methods available. Each type has its own advantages and disadvantages. We can divide the coding methods into 4 main types: Classical encryption, one-dimensional encryption, symmetric encryption, asymmetric encryption. And in this assignment, there are some types of encryption as follows

- Caesar Cipher: It is a classical substitution cipher. There are only 25 possible key options. A simple example of such a cipher replaces the letter of alphabet with a letter that is 5 paces ahead of it, for example "ABCD" will be converted into "EFGH".
- S-DES: The simple data encryption standard has a key generation process, but the S-DES key generation process creates two extra keys after processing the initial 10-bit input instead of using the key as for encryption and decryption code as the coding standard set out. Today it is no longer widely used because computing power has caught up with breaking it.
- RSA: RSA is an asymmetric encryption algorithm. It is one of the more commonly used encryption algorithms nowadays. Asymmetric encryption is an encryption method in which the encryption key is called the public key and the decryption key is called a different private key. For example: Company A sends important data to company B. The receiving company (company B) will generate a key encounter (public key and

private key). The sender (company A) before sending the data will encrypt the data using an asymmetric encryption algorithm with the public key from the recipient (company B). The recipient (company B) will decode the data received by the algorithm used by the sender, with the decryption key being the private key.

- Secure Socket Layer (SSL): SSL is a commonly-used protocol for managing the security of a message transmission on the Internet and it uses public and private key encryption system with 128 bit encryption (Rabia Latif, 2014).

6. Link to access and source code.

6.1 Link to access.

This is link Github code for ATN website.
https://github.com/truongbachinh/truongbachinh-assignment2cloud.

In Github, ensuring the security of the source of ATN Website I have made this repository private and add account ''DoQuocBinh'', my teacher who is a collaborator has access to my Link Github

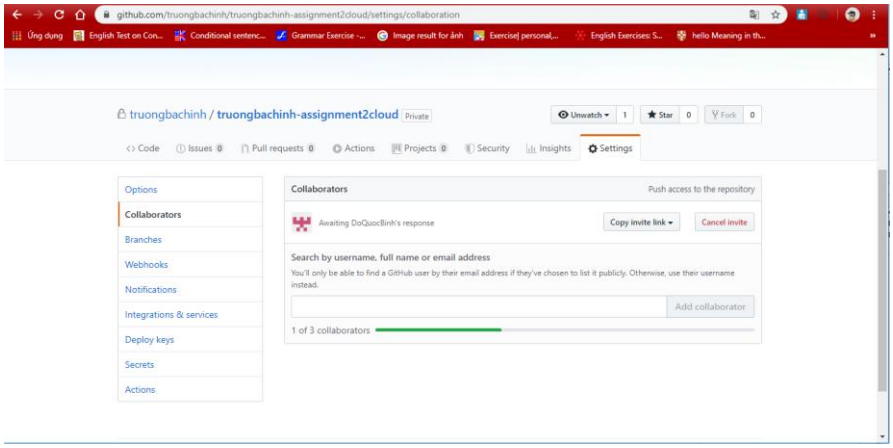


Figure 37 Add collaborators.

This is the link that leads to the index page of the ATN website.

https://truongbachinh-assigment2cloud.herokuapp.com/index.php

6.2 Source code.

The programming language: PHP, HTML, database: PostgreSQL pgAdmin4, Tools needed: GitHub, Visual Studio Code and framework: Bootstrap.

In figure 38, Source code connect to database using language php.

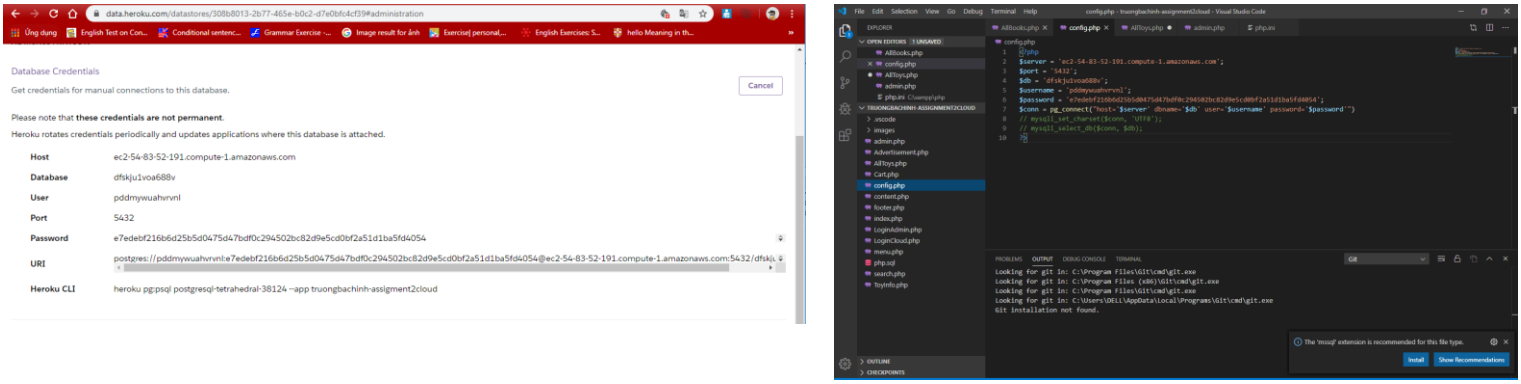


Figure 38 Connect database.

In figure 39 had showed the source code of Index page. In the index.php, the framework uses boostrap. Languages html, css, php. In the body of index.php include related files such as config.php, menu.php, content.php, footer.php.

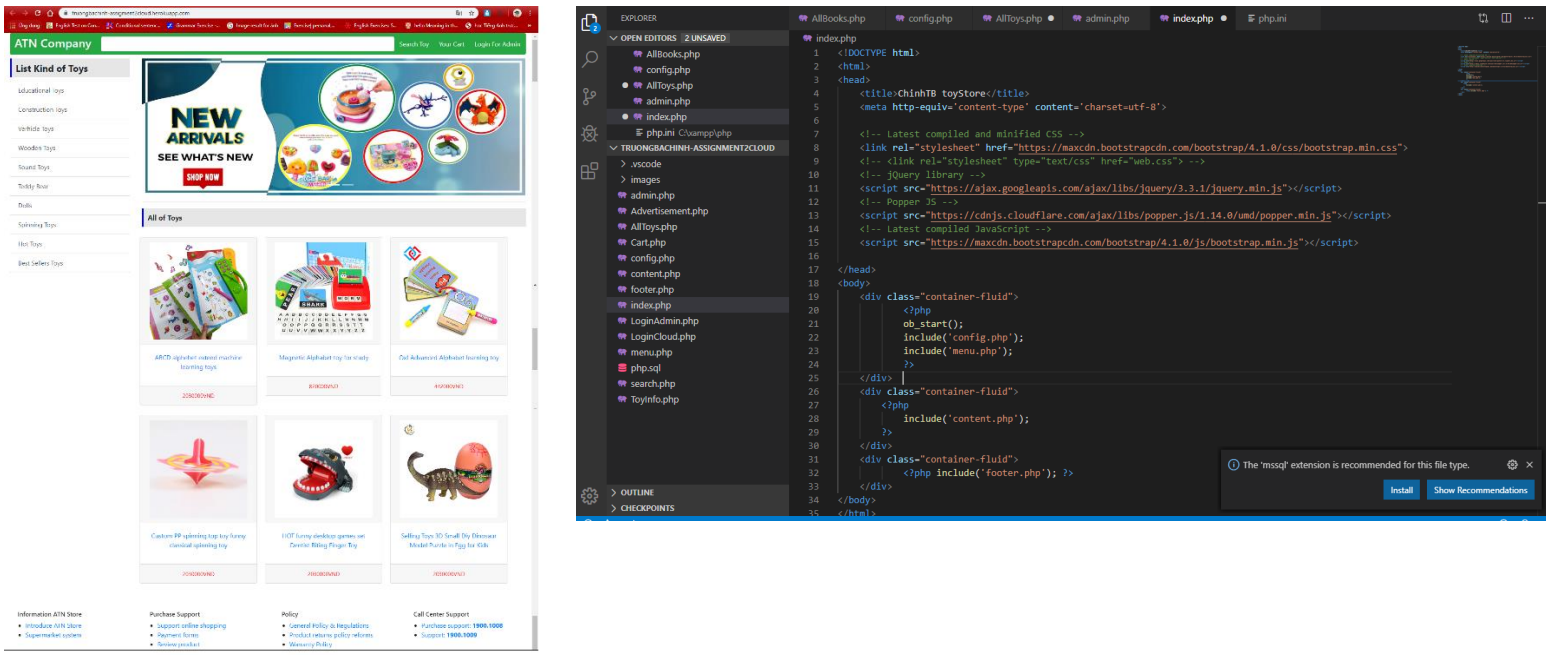


Figure 39 Source code for Index page.

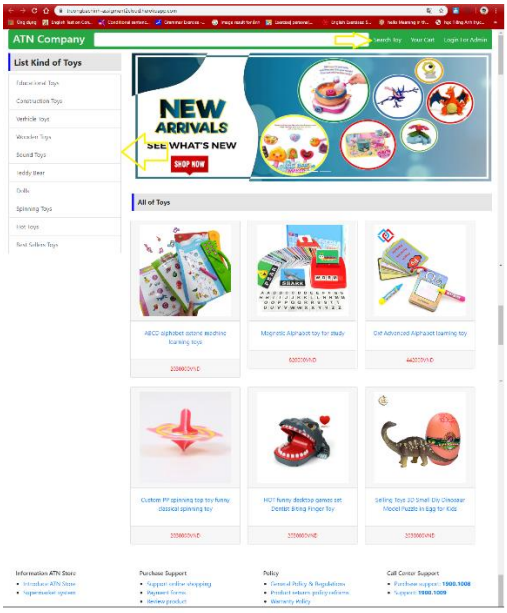
In Figure 40 showed the source code content.php with event-cutting functions to access and properly handle user actions on the website. For example, a link to the type of toy to find, a search button to display the type of toy to find. loginfAdmin button to access and update data. Cart button to show Cart.php.

content.php

```php
<div style="padding-top: 10px; padding-bottom: 10px">
    <div class="row">

        <div class="col-md-3" >
         <h1 style="background: #e6e6e6; padding: 10px; border-left: 5px solid blue; font-weight: bold; font-size: 24px;">L
            <div class="list-group">
                <a href="index.php?xem=search&idl=1" class="list-group-item list-group-item-action">Educational Toys</a>
                <a href="index.php?xem=search&idl=2" class="list-group-item list-group-item-action">Construction Toys</a>
                <a href="index.php?xem=search&idl=3" class="list-group-item list-group-item-action">Verhicle Toys</a>
                <a href="index.php?xem=search&idl=4" class="list-group-item list-group-item-action">Wooden Toys</a>
                <a href="index.php?xem=search&idl=5" class="list-group-item list-group-item-action">Sound Toys</a>
                <a href="index.php?xem=search&idl=6" class="list-group-item list-group-item-action">Teddy Bear</a>
                <a href="index.php?xem=search&idl=7" class="list-group-item list-group-item-action">Dolls</a>
                <a href="index.php?xem=search&idl=8" class="list-group-item list-group-item-action">Spinning Toys</a>
                <a href="index.php?xem=search&idl=9" class="list-group-item list-group-item-action">Hot Toys</a>
                <a href="index.php?xem=search&idl=10" class="list-group-item list-group-item-action">Best Sellers Toys</a>
            </div>
        </div>
        <div class="col-md-9">
            <?php
            session_start();

            $array=array();
            if (isset($_SESSION['array'])) {
                $array=$_SESSION['array'];
            }

            if(isset($_GET['xem'])){
                $t=$_GET['xem'];
            }else{
                $t='';
            }
            if(isset($_POST['searchButton']) || $t=='search'){
                include('search.php');
            }elseif(isset($_POST['loginWithGoogle'])){
                header('Location: LoginAdmin.php');
            }elseif($t=='ToyInfo'){
                include('ToyInfo.php');
            }elseif(isset($_POST['buy']) || isset($_POST['cart'])){
                if(isset($_POST['buy'])) {
                    array_push($array, $_POST['buy']);
                    $_SESSION['array']=$array;
                }
                include('Cart.php');
            }else{
                include('Advertisement.php');
                include('AllToys.php');
            }
            if(isset($_POST['cancel'])) {
                session_destroy();
            }

            if (isset($_POST["login"])) {
                $username = $_POST["username"];
                $password = $_POST["password"];
                if ($username == "" || $password =="") {
                    echo "<script type='text/javascript'>alert('Username hoặc Password bạn không được để trống!')</script>"
                } else {
                    $sql = "select * from admin where username = '$username' and password = '$password'";
                    $query = pg_query($conn,$sql);
                    if (pg_num_rows($query)==0) {
                        echo "<script type='text/javascript'>alert('username or password is incorrect.')</script>";
                    } else {
                        header('Location: admin.php');
                    }
                }
            }

            ?>
        </div>
```

Figure 40 Source code cut event.

In Figure 40 showed source for search function in ATN website. Languages that use PHP and. Use queries to search toy data from the database of pgAdmin 4.




```php
<?php
$and="";
if (isset($_GET['idl'])) {
    $and="and id_kindtoy='$_GET[idl]'";
}

$searchText="";
if (isset($_POST['searchText'])) {
    $searchText=$_POST['searchText'];
}

$sql_search="select * from toy where toyname LIKE '%$searchText%' " . $and;
$query_search=pg_query($conn, $sql_search);

$line_kind="";
if (isset($_GET['idl'])) {
    $sql_kind="select * from kindtoy where id='$_GET[idl]'";
    $query_kind=pg_query($conn, $sql_kind);
    $line_kind=pg_fetch_assoc($query_kind);
}
?>
```

Figure 41 Source for Search function.

In Figure 41 show the source code login for admin. Admin enter the correct password, it will be able to access to ‘’admin.php’’, or it will display the wrong account or password. Languages that use PHP, JavaScript and use queries to check account data from the database of pgAdmin 4.


```php
if (isset($_POST["login"])) {
    $username = $_POST["username"];
    $password = $_POST["password"];
    if ($username == "" || $password =="") {
        echo "<script type='text/javascript'>alert('Username hoặc Password bạn không được để trống!')</script>";
    } else {
        $sql = "select * from admin where username = '$username' and password = '$password'";
        $query = pg_query($conn,$sql);
        if (pg_num_rows($query)==0) {
            echo "<script type='text/javascript'>alert('username or password is incorrect.')</script>";
        } else {
            header('Location: admin.php');
        }
    }
}
```

Figure 42 Source code login for admin.

In Figure 42 showed the source of admin function in ATN website however the coding to long. So user can view clearly on Github. In the admin.php, using framework is boostrap. Languages html, CSS, PHP. So admin can delete, add and update.

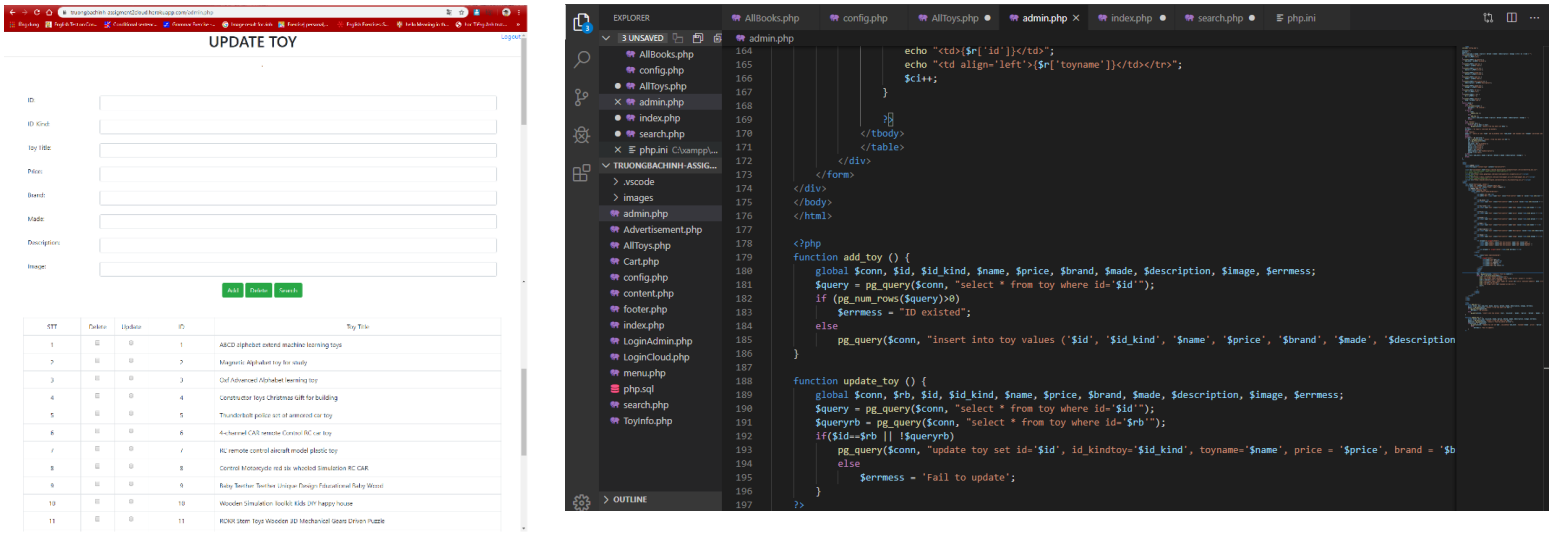


Figure 43 Source code for Admin function.

In Figure 43 showed the source code of your cart function for user can view the toy they had bought.

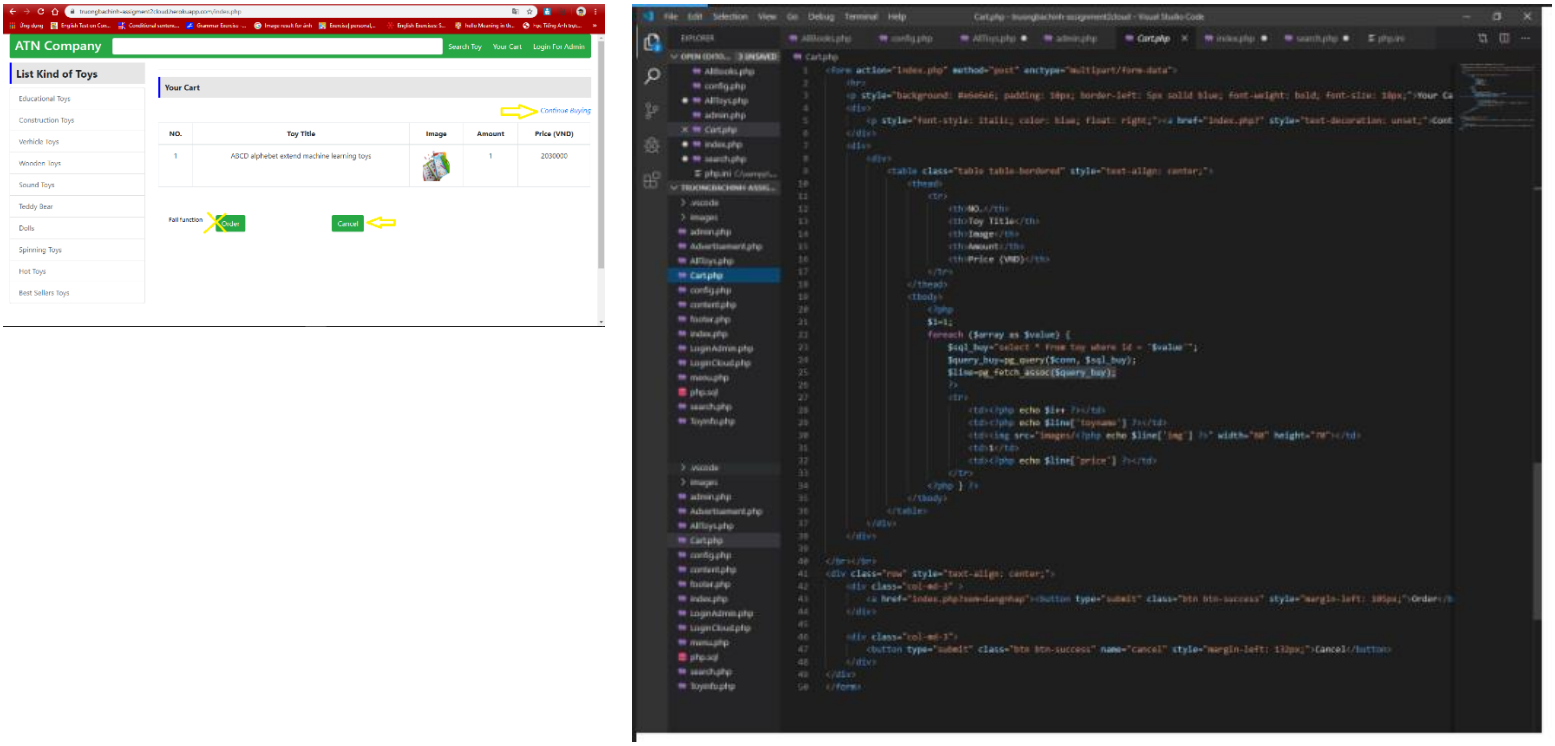


Figure 44 Source for Your cart function.

For understanding and have a more visual view of the source code, please read the link above Github. That will show all of source code of ATN website.

7 Conclusion.

ATN's website is built and 10 types of toys for teenagers such as educational toy, construction toy, sound toy... The ATN website also offers additional features for customers can view the entire product of the company, can search for products by name or by category. Besides, they can add toys to their shopping carts. For admin has the function of logging into the database system of the Website to add, delete and update data. Next, the general issues of using cloud computing have been raised such as security, performance... and how to solve them. Finally, cloud security was discussed and provided users with ways and tools to ensure their data on the cloud is protected and secure.

References

Bhadoria, A. (2014). *Basics of Cloud Computing.*

Chandrasekaran, K. (2014). *Essentials of Cloud Computing.*

codecademy. (2018, 9). *Visual Studio vs. Sublime Text: Which Editor Should You Choose?* Retrieved from codecademy.

Corporation, M. (2015). *Visual Studio Code*. Retrieved from Visual Studio Code: https://code.visualstudio.com/

FRANK PILHOFER, A. P. (2006). *Distributed Systems Architecture.*

James Lindenbaum, A. W. (2007). *Heroku*. Retrieved from Heroku.

Karl Reiner Lang, R. V. (2005). *A Pricing Mechanism for Digital Content Distribution Over Computer Networks.* J. of Management Information.

Lerdorf, R. (n.d.). *PHP*. Retrieved from PHP Programming language: https://www.php.net/

Mell, P. &. (2011). *The NIST Definition of Cloud Computing.* U.S. Department of Commerce: National Institute of Standards and Technology.

pgadmin. (n.d.). *pgAdmin PostgreSQL Tools*. Retrieved from pgadmin 4: https://www.pgadmin.org/

Rabia Latif, H. A. (2014). *Cloud Computing Risk Assessment: A Systematic Literature Review.*

Thomas Erl, Z. M. (2014). *Cloud Computing Concepts, Technology & Architecture .* United States of America.

Tom Preston-Werner, C. W. (2008). *GitHub Inc.* Retrieved from GitHub Inc.: https://github.com/