NUS Information Technology
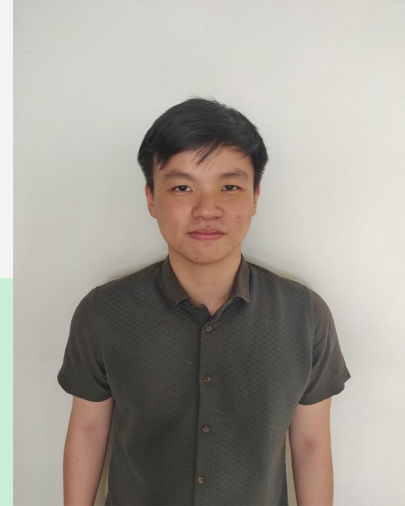
Research Computing Cloud
Development Internship

Yin YiRan

Ivan Andika Lie

Interns

Yin YiRan
Year 3 Information System
HPC Login Portal

Ivan Andika Lie
Year 2 Computer Engineering
Green Provisioning

HPC Login Portal

01

For users to register and check their account status

02

For administrators to manage HPC accounts, software available, announcements

Project Overview

User interface
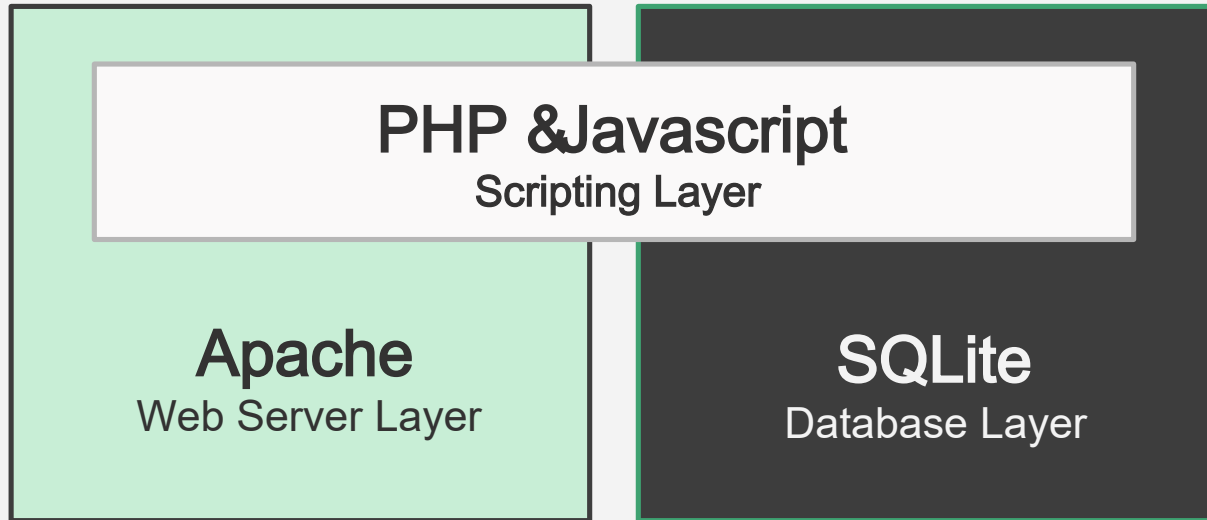
Improve the interface of HPC login portal
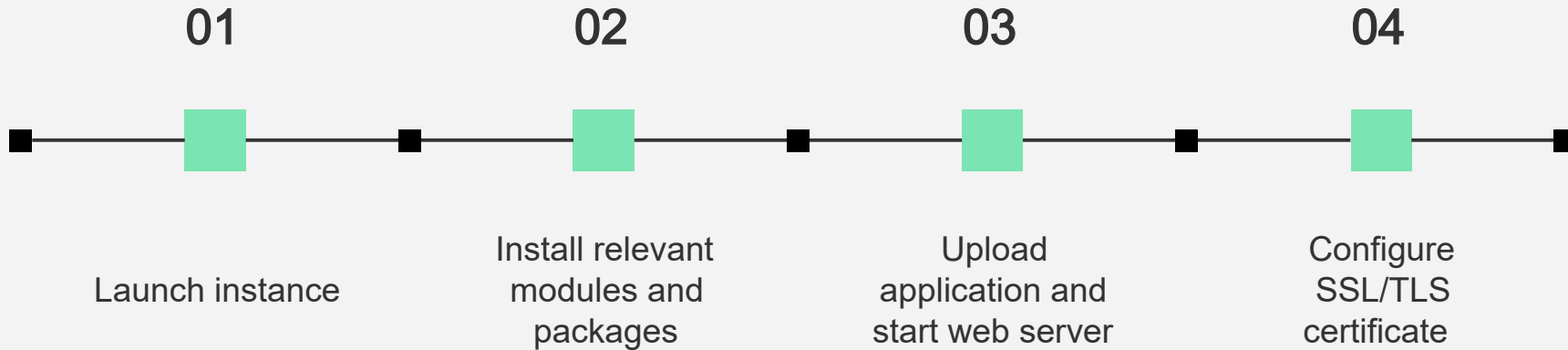
Security

Reduce portal's vulnerabilities

Deploy to cloud

From on-premise to AWS cloud

Technology stack

PHP &Javascript
Scripting Layer

Apache
Web Server Layer

SQLite
Database Layer

Cloud deployment

01

Launch instance

02

Install relevant
modules and
packages

03

Upload
application and
start web server

04

Configure
SSL/TLS
certificate

Login page

Register for HPC Services

Username	e02014
Password	••••••••
Domain	NUSSTF

Submit

Existing users, please skip.

- New announcement section
- Cleaner view

Register for HPC Services

[Username]

[Password]

[Domain ▼]

Submit

Useful Information/Announcement

HPC resources are open to all NUS staff and students who have a valid NUSNET id with the need to access high-performance computing resources.

Go to https://nusit.nus.edu.sg/services/getting-started/registration-guide/ to read the procedure and start registration.
After registration, wait for about 1 hour, you will be able to use the userid and password to access all HPC resources. The NUSNET password is valid throughout all the hosts. As the access control and authentication of all HPC servers are through NUSNET account, change of NUSNET password will automatically take effect on all HPC servers. You are using your NUSNET account to access HPC services. You can change your password at exchange.nus.edu.sg.

Welcome page

Welcome e0201401!   [logout]

Access to HPC Services

Access interactive & visual term
visualization, code compilation, l
other computation

Run biology-related applications

Name	
Yin Yiran	
Username	
e0201401	
Position	
Undergraduate	
Department	
Information Systems	

logout

Access to HPC Services

Access interactive & visual terminals - for modelling, visualization, code compilation, batch job submission and other computation

HPC Portal

Update

Project title/Course name*:
Research Computing Cloud Developments

Supervisor/Course instructor name*:
Yeo Eng Hee

Software used:

Reason for using HPC resources at SVU/Computer Centre*:
Student internship for Research Computing Cloud Developments

Research objective*:
Research Computing Cloud Developments Internship

Registration page

- Added more validation
- Word limit
- Special characters
- Sectioned the form to minimise scrolling

Register for HPC Services

─ Personal Information ─────────────

Username*:
Domain*:
Name*:
Position*: Staff
Department*:

─ Project Details ─────────────

Project title/Course name*:
Supervisor/Course instructor name*:
NUS Internal collaborator name :
Internal collaborator position :
Internal collaborator department :
Industry partner name:
Industry partner

Register for HPC Services

Project Details

Project title/Course name*:

Research Computing Cloud Developments

Supervisor/Course instructor name*:

Please fill in this field

NUS Internal collaborator name :

$

Please do not use special characters like $, ', ', /, \.

Internal collaborator position :

Internal collaborator department :

Previous Next

Admin page

- New announcement tab to edit or add announcements
- Menu bar for easier navigation
- Made buttons more visible

Improvements

Lessons Learnt

01

AWS Cloud

02

Basic Linux system administration

03

Apache server and PHP Programming

Thank you!

Green Provisioning in NUS HPC Cloud Environment

NUS Information Technology

Ivan Andika Lie

Objectives

1. Optimize the use of the cloud resources and to minimize costs

2. Customize the automatic scaling of cloud resources to our requirements

3. Help provision cloud resources to NUS departments, when required

NUS HPC Cloud Environment

- Uses PBS (Portable Batch System) Pro

- Distributed workload management system which manages and monitors the computation workload on a set of one or more computers

- Hosted on Amazon Web Services (AWS) – Cloud Provider

- Uses EC2 (Elastic Compute Cloud) in an isolated Virtual Private Cloud (VPC) for security

Initial HPC Complex

- 2 Login Nodes (Scheduler and Server)

- 6 Static Compute Nodes (MoM)
 - Powered on all the time
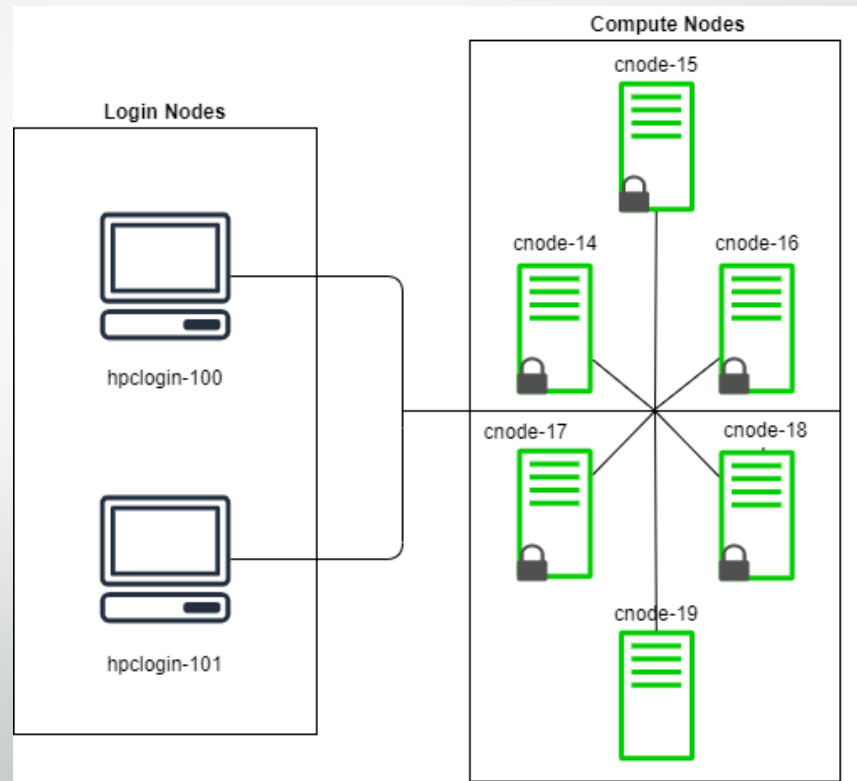
Project Outline – Green Provisioning

- Making use of PBS Pro Green Provisioning Package to achieve the following:

  - Reduce costs by intelligently scheduling power management based on predicted and actual utilization

  - Provide the ability to schedule jobs to minimize the use of compute nodes, and provides a shut-down service when computing resources are not in use

- To customize this package for the HPC cloud environment

Comparison with Alternative Solutions

- EC2 Auto Scaling
  - AWS native tool to automatically scale the compute nodes
  - Incompatible with PBS Scheduler resource management
    - Doesn't scale based on the HPC workload in the job scheduler
- PBS Pro Proprietary Solution
  - Commercial solution by PBS Pro
  - Not available in our PBS license package – additional cost required
- Green Provisioning is the free customizable package offered by PBS Pro to meet our needs
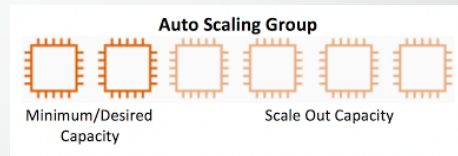
Project Timeline

Familiarisation
- PBS Pro and AWS Services

Development and Testing
- Green Provisioning in Test Environment: 1 login node and 6 test compute nodes (3 static, 3 dynamic)

Deployment to the PBS Production Complex
- 4 Statics Compute Nodes, 8 Dynamic Compute Nodes

Provisioning Cloud Resources to NUS Departments

- Assist the Data Analytics Consultancy Centre under the Department of Statistics and Applied Probability to have their own **dedicated** and **secure** AWS Cloud Environment to create instances tailored to run Deep Learning Tasks

- Prepare presentations and troubleshoot any problems encountered by the users

- Ensure smooth transitions and handover of the cloud environment to their administrators

Lesson Learnt

- Cloud SysOps Administration Skills
  - Understand the AWS Cloud Environment
  - Able to make cost and benefit consideration about a service
  - Good AWS Practices
- Practical Unix/Linux system administration
  - System admins knowledge
  - Write Linux service, scripts, general OS, and networking knowledge
- HPC job management and optimisation in Cloud Environment
- Web portal and web services development in the Cloud

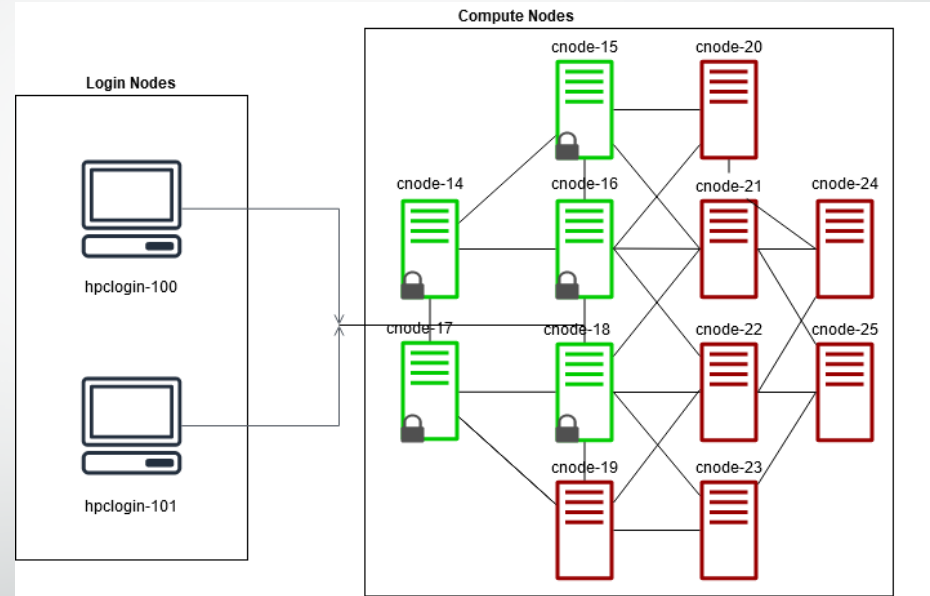# Challenges Faced and Innovation Opportunities

- Green Provisioning Package lacks Documentation
  - Have to dive into the implementation (codes and logs)
- Green Provisioning Package are not updated extensively by Altair
  - Have some bugs which need to be squashed
  - Need to write scripts tailored to suit our needs
- Green Provisioning Package are designed for on-premise use
  - Need to write scripts that uses AWS Cloud SDK to boot nodes, shutdown nodes, and get the status of the nodes.

Demo
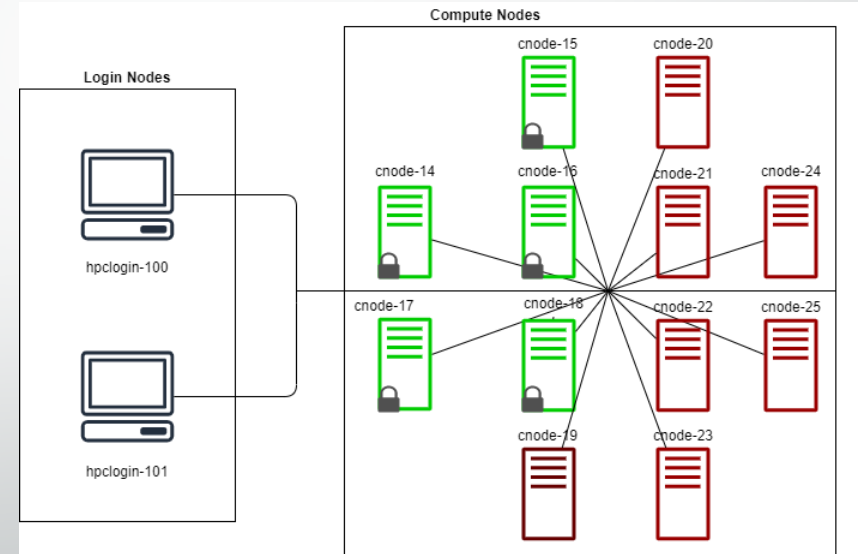
Upgraded HPC Complex

- 2 Login Nodes (Scheduler and Server)
- **5 Static** Compute Nodes
  - Powered on all the time
- **6 Dynamic** Compute Nodes
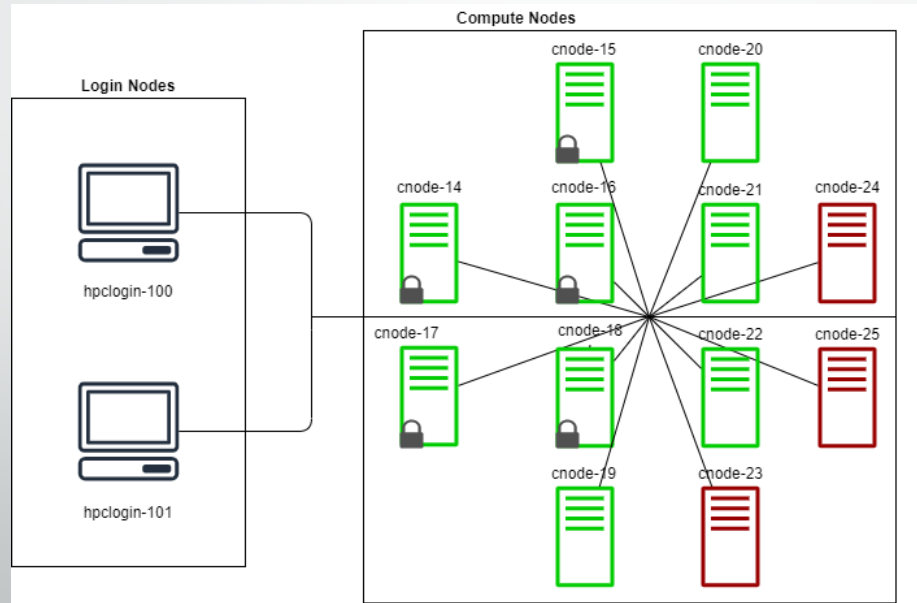 - Only powered on when needed

Initially all the nodes are off

When jobs exceed the capacity of the static nodes, Green Provisioning Package will boot the dynamic nodes

After the jobs finished running, the dynamic nodes will check if there are any jobs queued for them. If not, they will shut down after a short idle period
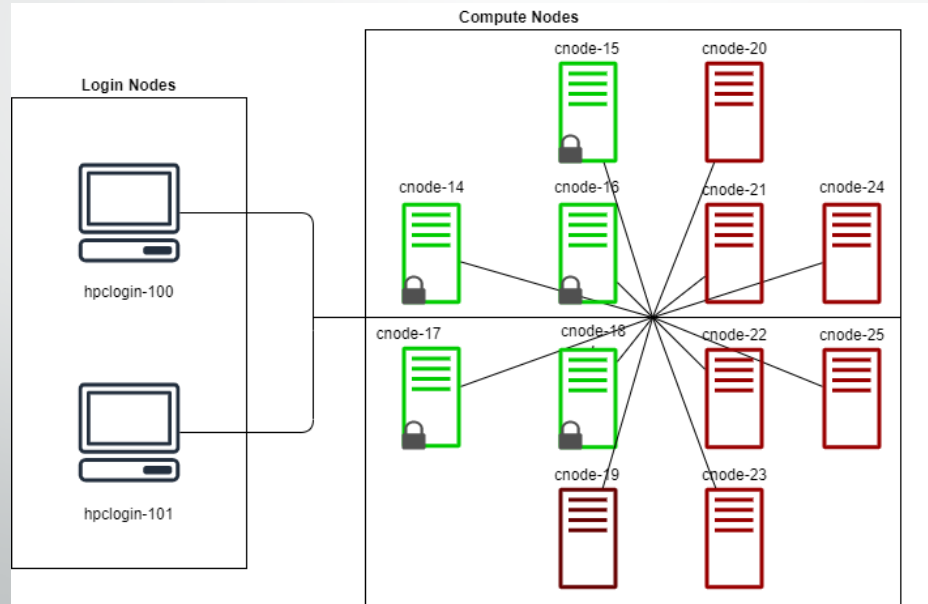
Further Improvements

- Using Spot instances for a more cost effective use of the dynamic nodes

  - Spot instances are heavily discounted cloud instances (up to 90% discount) for short interruptible workloads

- Configure to work for more than one queue and more instances based on workload requirements

Thank you!

Any question?