Summer Fellowship Report

On

Creating Spoken Tutorials for ns-3

Submitted by

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Acknowledgment

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Chapter 1

Introduction

The Spoken Tutorial project is an online learning platform that hosts video tutorials on Free and Open Source Software (FOSS). The tutorials are developed and intended to allow the learner to learn at their own pace, from anywhere with a computer and an internet connection. Effort is made to make the tutorials as simple as possible, with minimum pre-requisite knowledge required.

To promote practical learning, maximum duration of the tutorial is devoted to demonstration of the topic, and all the required files for learning, including the source files used in the tutorial, are provided to the learners. To enable the learners to get a better grasp of the concept, practice problems are given at the end of each tutorial, that can be solved using the concepts covered in that tutorial. To get better clarity, the learners can post their queries to the tutorial-specific forum, where domain experts resolve them by providing explanation.

The Spoken Tutorial project also offers certifications, that require the learners to pass an online assessment.

Chapter 2

Tutorials on ns-3

ns-3 is a command line tool to simulate computer networks, based on C++. It enables creating different types of network topologies, like point-to-point, CSMA bus, star etc. It includes classes and methods to create nodes, set network parameters, configure client and server applications, send packets, etc. NetAnim is a visualising tool that comes bundled with an ns-3 installation. It allows the users to visualize the networks created in ns-3.

This tutorial covers ns-3 and NetAnim from the very beginning, from creating nodes and connecting them using a point-to-point network. To the end of the series, more advanced concepts, like congestion control, and WiFi networks are also demonstrated. The tutorials are aimed at undergraduate and graduate students, who have basic understanding of networking concepts and have hands-on experience with Linux and C++ programming language.

2.1 Installation of Network Simulator-3

This tutorial demonstrates the procedure of installing ns-3 and the required packages to run ns-3 programs. This tutorial have also covered the installation of a stable version of netanim as the default version available is not compatible to visualize the wireless networks.

The tutorial covers the following:

- About ns-3

- Downloading the software

- Updating the system

- Downloading packages.txt

- Installing the packages mentioned in packages text file

- Unzipping the downloaded file

- Using the terminal for building the software

- Installing NetAnim

- Running a sample program

- Features of ns-3

2.2   CSMA based network with bus topology

This tutorial helps the learner understand on how to create a CSMA based network with the bus topology.

The tutorial covers the following:

- Defining the topology

- Classes and methods description

- Initializing bus topology

- Setting default parameters

- Installing Server and client applications on node 1 and node 10

- Calculating delay and throughput

- Populating routing tables for the topology

- To Run simulation

- Observing delay and throughput in terminal window

- Visualizing through NetAnim

2.3   Creating TCP/UDP flow with star topology

This tutorial demonstrates creating both TCP and UDP flows using star topology. The routing is visualized using NetAnim.

The tutorial covers the following:

- Defining the topology

- Classes and Methods required

- Building Star topology using p2p links

- Setting constant parameters like Dataflow and delay

- Creating TCP flow

- Setting the attribute to remote

- Creating UDP flow

- To run the simulation

- Initializing flow monitor

- Analyzing the flow using flow monitor

- Observing Throughput and delay of the flow

2.4   Infrastructure based wireless network

This tutorial demonstrates the code to create an infrastructure based wireless network and also to visualize the network using netanim.

The tutorial covers the following:

- Creating nodes for the topology.

- To put the network Interface cards together

- Setting the wifi channel attributes

- Connecting the wifi devices to the channel

- Adding MAC addresses and assign SSID to devices.

- Setting up Station nodes and Access points of the network.

- Installing mobility helper to the nodes.

- Installing internet stack on the nodes.

- Assigning IP addresses.

- Creating UDP flows.

- Scheduling the simulator.

- Analyzing the flow using a flow monitor.

- Generating XML file.

- Observing the flow details .

- Visualizing the network infrastructure.

2.5   Creating an Ad-hoc wireless network

This tutorial demonstrates the creation of Ad-hoc wireless network. Also the parameters such as throughput and delay is analysed along with visualizing the network.

The tutorial covers the following:

- Creating nodes for the topology.

- To put the network Interface cards together.

- Setting the wifi channel attributes.

- Connecting the wifi devices to the channel.

- Adding MAC addresses and set the network to Ad-hoc mode.

- Installing mobility helper to the nodes.

- Installing internet stack on the nodes.

- Assigning IP addresses.

- Creating UDP flows.

- Scheduling the simulator.

- Analyzing the flow using a flow monitor.

- Generating a XML file.

- Observing the flow details .

- Visualizing the network infrastructure.

Chapter 3

Code and Script Writing

For the tutorials listed in the previous chapter, I developed the source code,the corresponding script with the visual cues and the narration and have recorded the videos. The scripts were written by strictly following the Spoken Tutorial norms. Effort was put on explaining each and every bit of the code, and relevant references were provided if a concept required pre-requisite knowledge and could not be covered in the tutorial itself. The tutorials were carefully recorded using vokoscreenNG app satisfying all the norms of recording videos.

The source code and the corresponding scripts can be found in the following links:

- Installation of Network Simulator-3

  Code: packages.txt

  Script: Tutorial-1_Installation of Network Simulator-3

- CSMA based network with bus topology

  Code: csma_performance.cc

  Script: Tutorial-4_CSMA based network with bus topology

- Creating TCP/UDP flow with star topology

  Code: flow2final.cc

  Script: Tutorial_7-TCP/UDP flow using Star Topology

- Infrastructure based wifi networks

  Code: wifi-simple-infra.cc

  Script: Tutorial-9_Infrastructure based wireless network

- Creating an Ad-hoc wireless network

  Code: wifi-simple-adhoc-grid.cc

  Script: Tutorial-10_Creating an Ad-hoc wireless network

Chapter 4

Creating slides

Following the development of code and script, I also developed slides for each tutorial. These slides contain the introduction, the system requirements and the prerequisites, and the network topology diagram. Additionally, for some tutorials, the slides also contain brief theory on the topic. The concluding slides give a summary of the concepts covered in the tutorial, and give some practice problems for the learners to solve.

The slides for the tutorials can be found at the following links:

- Installation of Network Simulator-3

- CSMA based Network with bus topology

- Creating TCP/UDP flow with Star Topology

- Infrastructure based Wireless Network

- Creating an Ad-hoc wireless network

Chapter 5

Phases of my Spoken Tutorial

After the code, scripts, and the slides were written for all the tutorials, a series of checks were done by the Spoken Tutorial team to ensure that the content follows all the norms and rules, and that it is well explained.

5.1   Outline

Creating an outline is the first step in the creation of a spoken tutorial. Outline of the spoken tutorial gives an understanding about the contents explained in the tutorial.

5.2   Script

A script is the written guide of the actions done in the tutorial. Every action small or big done during the tutorial is written in the script. The script strictly adheres to the Spoken tutorial guidelines and is made in a simple and straightforward manner.

5.3   Slides

Slides are made to help understand the theory concepts better. The slides are made using LaTeX for good layout and presentation. Color and format used in the slides of a tutorial is uniform throughout the series of tutorials in accordance with the ST guidelines.

5.4   Novice Check

Novice check is a process wherein, the script and source code files are given to a person who does not have any prior knowledge on the topic of the tutorial. The person then follows the script and performs the tasks and operations mentioned in it. He or she then gives their feedback whether the script is easy enough to follow for a complete beginner, and if all the steps could be followed without encountering any errors or issues.

The Novice check for my tutorials were performed by Ms. Vineeta from the Spoken Tutorial team. She performed the check multiple times to ensure that the content is well explained and that the source code is bug-free.

5.5   Domain Check

In domain check, source code and scripts are analysed by subject experts, to ensure that the code is correct, and that the terms used and explanations provided are satisfactory. The domain check was performed by Dr. Anita X and Dr. Radha R from VIT Chennai, and Dr. Moyukh Laha from IIT Kharapgur.

5.6   Admin Check

After the domain check and the novice check, the admin check is done to check if all the norms are followed, and if any improvements can be made to make the tutorials easier to follow or provide better clarity. The admin check was done by Ms. Nirmala from the Spoken Tutorial team.

5.7   Recording

The video is recorded according to the ST guidelines. The video is recorded with high quality and will strictly follow the script and avoid unwanted information.My video making procedures were guided by Ms. Madhuri from Spoken Tutorial team.

Chapter 6

Conclusion

The FOSSEE fellowship, apart from giving me an opportunity to contribute to the Spoken Tutorial learning platform and exercise my programming skills, also helped me pick up skills like project management and team work. While writing the scripts, I learned the importance of writing clean code and good documentation, to provide the best learning experience for the viewers. I also discovered the wide formatting capabilities of LaTeX while creating the slides for the tutorials.

I would again like to thank the Spoken Tutorial team and my mentors at VIT Chennai for providing me this opportunity.

References

- https://www.nsnam.org/

- https://spoken-tutorial.org/