Deep Learning Analysis and Optimization of Security Infrastructure

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November 21, 2021

Abstract

This paper describes a project.

1 Deep Learning Analysis and Optimization of Security Infrastructure

The Terraform software made by Hashicorp is typically used as a means of automating network infrastructure deployments. Our teams produce Terraform modules and code frequently.

2 About Graph Neural Networks

While an in depth explanation of graph theory is beyond the scope of this paper, some background will be provided here to make the paper accessible to a wider audience. A collection of related references will be included at the end of this paper for those who may be interested.

3 Gathering Data

Once a Terraform code base has been initialized, the user has the option to generate a directed graph of the infrastructure. Consider the following declaration of a Cloud Function for Google Cloud.

3.1: Terraform Declaration Example

```
resource "google_project_service" "cloud_function" {
  project                    = var.project_id
  service                    = "cloudfunctions.googleapis.com"
  disable_on_destroy         = false
  disable_dependent_services = false
}
```

Graphviz is open source graph visualization software. Graph visualization is a way of representing structural information as diagrams of abstract graphs and networks. DOT is a language used to describe graphs. Conversion of Terraform HCL to a directed graph representation is trivial thanks to Graphviz and Dot.

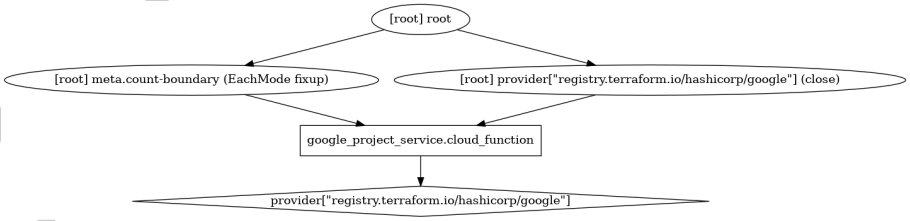

Figure 1: DOT output from Terraform Files as a pygraph

Once our Terraform files have been output as a directed graph, we need to bring it in to Python so we can perform operations on it. To run Terraform commands in an automated fashion, the python-terraform module is used.

Directed graphs are ingested into Python as an object using the networkx module. Now we are ready to perform operations on the digraph, displayed in the following figure.

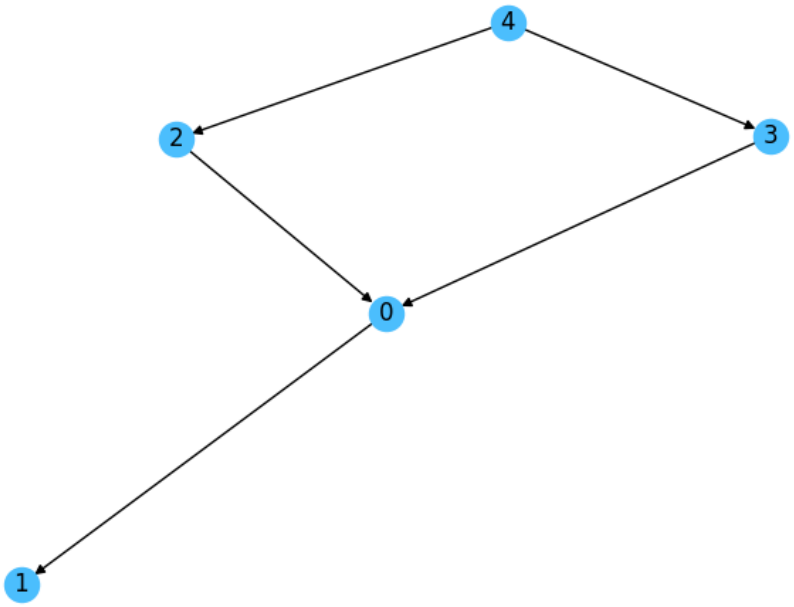

Figure 2: Directed graph ingested by networx

Note that new numerical labels are displayed in place of the original labels, which are stored in the node objects in case we need them later.

3.1 The Adjacency Matrix

This module also provides an easy means of converting our graph into an adjacency matrix, which is a mathematical representation of our graph. The nodes are represented in a columnar format known as a matrix.

features

Revision History

Revision	Date	Author(s)	Description
v0.1	Nov. 20th, 2021	Franklin Diaz	Initial Draft

References

[1] Davide Bacciu, Federico Errica, Alessio Micheli, and Marco Podda. A gentle introduction to deep learning for graphs. *CoRR*, abs/1912.12693, 2019.

[2] William L. Hamilton, Rex Ying, and Jure Leskovec. Representation learning on graphs: Methods and applications. *CoRR*, abs/1709.05584, 2017.