PROJECT HEXALL

(Hexall-A Real time disaster prediction and management system)

GOAL OF THIS PROJECT :

TO PREDICT THE PROBABILITY OF OCCURRENCE OF AN AFTERSHOCK WITH 80% OR MORE ACCURACY AND TO CATER TO THE NEEDS OF THE PEOPLE AFFECTED BY THE DISASTER THROUGH OUR APP ,SMS/SOS SYSTEM.

TECHNOLOGIES AT OUR DISPOSAL

1. A DEEP LEARNING MODEL IN PYTHON WHICH IS A FORECAST PREDICTION SYSTEM FOR GIVING PLAUSIBLE RESULTS FOR PREDICTING THE PROBABILITY OF AN AFTERSHOCK IN A WIDE REDUON OF INTERSET ,GIVEN AN TREMOR OR A SMALL EARTHQUAKE HAS BEEN REALISED.

2. MATLAB HAS BEEN USED FOR STATISTICAL ANALYSIS AND DATASET GENERATION .

3.TENSORFLOW AND KERAS LIBRARIES HAVE BEEN USED TO TRAIN THE MODEL.

4.CALLING UGCS BASED JSON FILES FOR REAL TIME GEOMAPPING ,WHICH KEEPS TRACK OF ALL EARTHQUAKES WHICH HAVE OCCURRED OVER ANY REGION. THE SCRIPT ALSO USES LEAFLETJS.

5.TWILIO API FOR THE MESSAGING SERVICE .

6.THE WEP APP , TAKES ADVANTAGE OF JAVASCRIPT , HTML AND FLASK.

7.THE MODEL HAS BEEN DEPLOYED ON MICROSOFT AZURE USING AZURE APPSERVICE.

8.FLASK, FIREBASE, AZURE APPSERVICES, JAVASCRIPT, HTML.

WORKFLOW OF THE SYSTEM

OUR DEEP LEARNING MODEL GETS DATA INPUT FROM REALTIME SOURCES AT SPECIFIC INTERVALS. IN CASE AN AFTERSHOCK IS PREDICTED, AN SMS BROADCAST IS SENT TO CONCERNED AUTHORITIES AND LOCALS. THE APPLICATION IS A DISASTER HELPLINE / RELIEF APPLICATION WHICH CAN BE USED BY PEOPLE TO CONTACT AUTHORITIES AND HELP AUTHORITIES TO CONDUCT NECESSARY ACTIONS. THE APP HAS MULTIPLE FEATURES SUCH AS SOS AND MISSING PERSON, WHICH ALERT THE AUTHORITIES TO INITIATE A RELIEF/SEARCH OPERATION. USERS CAN ALSO SEND AN SMS TO OUR PHONE NUMBER IF THEY DO NOT HAVE INTERNET ACCESS TO MAKE USE OF THE SAME FEATURES.

MOTIVATION BEHIND THE IDEA

CURRENTLY PEOPLE HAVE BEEN USING THE COULOMB'S STRESS CRITERION TO EXPLAIN THE SPATIAL DISTRIBUTIONS OF AFTERSHOCKS, BUT SOMETIMES VERY IMPORTANT PATTERNS GO UNNOTICED .

AFTERSHOCKS ARE A RESPONSE TO CHANGES IN STRESS GENERATED BY LARGE EARTHQUAKES AND REPRESENT THE MOST COMMON OBSERVATIONS OF THE TRIGGERING OF EARTHQUAKES. THE DEEP-LEARNING MODEL THAT WE HAVE DEVELOPED ARE TRAINED AND TESTED USING CO-SEISMIC SLIP DISTRIBUTIONS FROM THE SRCMOD ONLINE DATABASE OF FINITE-FAULT RUPTURE MODELS.(FSP FORMAT FILES)

DEEP LEARNING MODEL :

THE OUTPUT OF THIS FINAL NEURON (SIGMOID FUNCTION) MAY BE INTERPRETED AS THE PREDICTED PROBABILITY THAT A GRID CELL GENERATES ONE OR MORE AFTERSHOCKS.

WE ASSESS THE ACCURACY OF THE NEURAL-NETWORK AFTERSHOCK LOCATION FORECASTS ON THE TEST DATASET USING RECEIVER OPERATING CHARACTERISTIC ANALYSIS. THE MERGED AUC VALUE ACROSS ALL SLIP DISTRIBUTIONS AND GRID CELLS IN THE TEST DATASET FOR OUR NEURAL-NETWORK FORECAST IS MUCH LARGER THAN THE COULOMBIC FAILURE STRESS CRITERION.

THE IDEA IS TO OBSERVE A VOLUME WHICH EXTENDS BY 'K' KMS HORIZONTALLY 'V' KM VERTICALLY FROM THE MAIN SHOCK.

IN OUR NETWORK , K IS 100 AND V IS 50.

1.DISTRIBUTE THE VOLUME INTO 5KM X 5KM X 5KM SMALL VOLUMES. 2.ELASTIC 'STRESS CHANGE TENSORS' AT EACH OF THEIR CENTROID. 3.PREDICT WHETHER THERE WAS AN AFTERSHOCK IN THAT SMALL VOLUME OR NOT

AFTERSHOCK AND AFTEREFFECTS PREDICTION IS THE FINAL OUTPUT
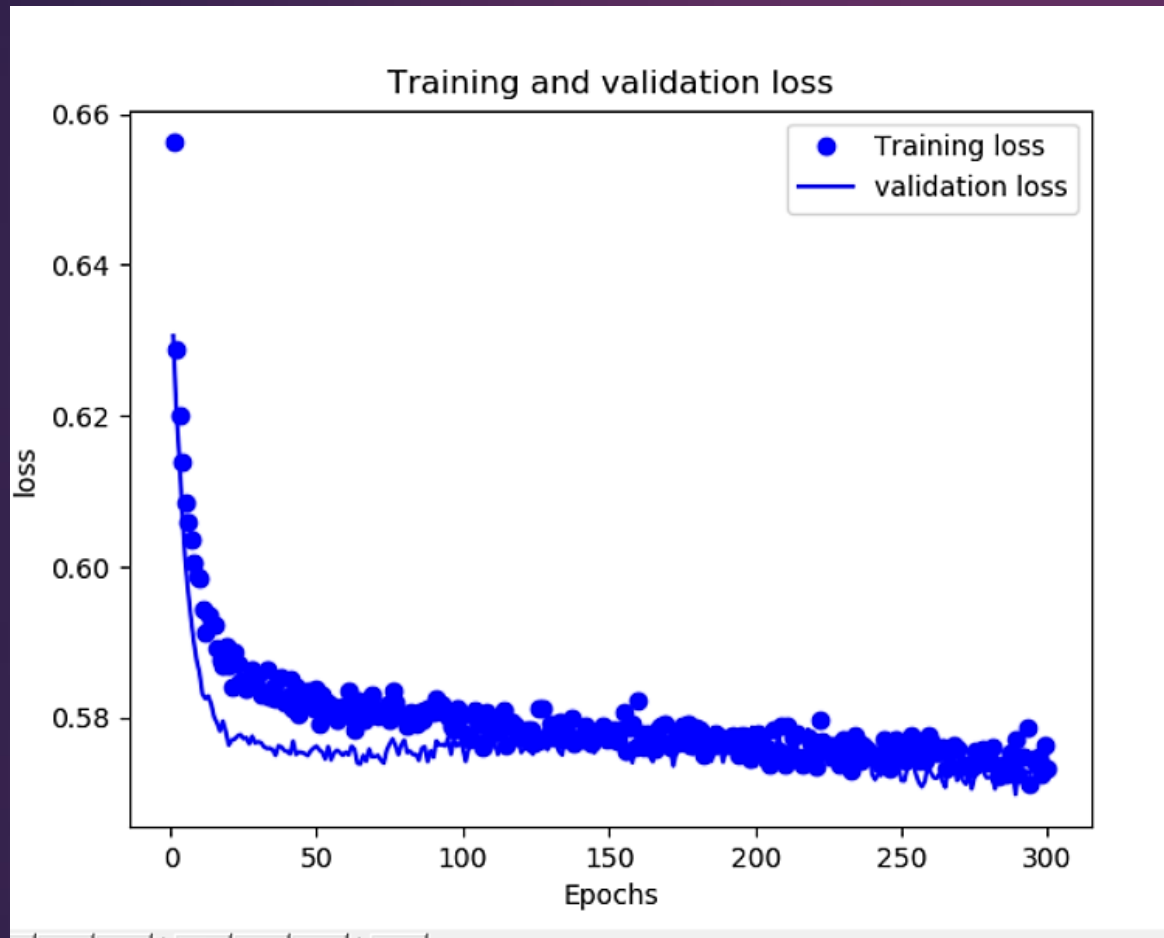
OUTPUTS OF THE NEURAL NETWORK.

Training and validation loss

MERGED AUC SOCRE ON
TESTING DATA FOR THE PAST 20
YEARS : 0.84

EPOCHS=300
BATCH SIZE=4000

DEVELOPMENT PART OF THE PROJECT :

ONCE AN AFTERSHOCK HAS BEEN PREDICTED , ALL THE USERS ARE ALERTED VIA A SOS TEXT MESSAGE .THIS PART OF THE APP USES TWILIO MESSAGING SERVICE FLASK AND FLUTTER. USERS ARE PROVIDED WITH A MAP WHICH DISPLAYS ALL THE EARTHQUAKES THAT HAVE BEEN OCCURRING , WITH THEIR MAGNITUDES AND LOCATIONS . THE MAP ALSO HAS THE FACILITY TO SHOW ALL THE TECTONIC PLATE BOUNDARIES IN SATELLITE VIEW. FURTHERMORE , THE MESSAGING SERVICE ALERTS ALL THE RELIEF CAMPS AND NEARBY HELP CENTRES WHICH ALLOWS A QUICK RESPONSE IN THE CASE OF A LARGE CALAMITY.

WITH AN ACCURACY OF 88% , OUR MODEL ALLOWS SAFETY AND EVACUATION BEFOREHAND.

OUR USER-HELPLINE MODULE ACCEPTS *SMS* WHICH CAN HANDLE *SOS , MISSING AND ASAP* REQUESTS.

OUR NATIVE APP HELPS AUTHORITIES TO ANALYZE THE DISASTERS AND FURTHER PATTERNS.

THE TEST-DL TAB ALLOWS THE AUTHORITY TO OVERRIDE THE REALTIME INPUT TO DL-MODULE AND INPUT VALUES TO GET AN OUTPUT.

AUTHORITY MAP(EARTHQUAKE ANALYSIS SYSTEM OUTPUT) ONLINE

https://rajatshenoy.com/hexall-disaster-helpline/maps/aftershock.html

PROJECT HEXALL AIMS TO PREDICT EARTHQUAKE AFTEREFFECTS , WHICH IN TURN WILL ALSO HELP US PREDICT THE POSSIBILITY OF A TSUNAMI .

AN EFFICIENT AND LIGHT-WEIGHT USER HELPLINE SYSTEM WILL ALERT ALL THE CIVILIANS OF THE CALAMITY STRUCK REGION , WHICH WILL HELP IN SAVING PRECIOUS HUMAN LIVES .

THE FAST FUNCTIONING SOS SYSTEM AND THE MESSAGE , MISSING PERSON ALERT , ALONG WITH ADDITIONAL FEATURES OF THE MAP ALLOWS THE RESCUE TEAMS TO PLAN AND MANAGE DISASTER WAY AHEAD OF TIME , SOMETHING WHICH IS THE NEED OF THE HOUR \

THE PROJECT HAS BEEN PUSHED TO GITHUB UNDER OUR REPOSITORY .

IT HAS BEEN INTEGRATED SUCCESSFULLY ON OUR SYSTEMS.

FUTURE PLAN OF ACTION AND PROJECTS:

WE ARE CURRENTLY WORKING TOWARDS CREATING 'GODS-EYE' WHICH CAN ALERT THE USER BEFORE-TIME OF THE DISASTER WHICH WILL OCCUR.

DETAILS FOR THE SAME WILL BE REVEALED SOON.

SIGNING OFF ,

TEAM HEXALL

TEAM MEMBERS:

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