**Project:** Connected Emergency Response **Learning Team-Suite (CERLT-S)**

**Subject Area:** Connected Emergency Response Learning Tools (CERLT)

**Authored on:** 14/09/2021 and still work in progress as solution finding was more important than coding a small part of the CERLT-S

**Team:** AOEC

**Team members:**

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For: SAAI Factory Hackathon

Submission: Green Globe Codification to help connected emergency response at sites

Help learn from Sense and Respond Drills, Evacuations and Analysis to improve the use of art/art form/art work/allied innovation in assistants that are part of an A-Z (CERC) assistant portfolio

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**## 1. Inspiration**

We at AOEC find that "connected emergency response” can help many occupants where different LifeScore abilities are considered to help prepare for, sensitize, strategize and respond to swiftly save and protect life.

We at AOEC have hosted a proof of concept URL to develop this further. As a part of this ...

The Connected Emergency Response Learning Team-Suite is a framework of CERC Tools that use machine learning for different assistants to enable CERC Sense & Response systems, Social Accountability and a Bio-centrism to sensitize occupants or responders to mitigate risk, emerge & procreate.

The project will showcase Connected Emergency Response Learning for a Connected Emergency Response Centre and its A-Z (CERC) assistant framework.

**Responsive & Sustainable development** is termed as development that meets the needs for life score codification, risk mitigation and disaster management for trends seen or futuristically possible.

**Connected Emergency Response Centres** need to be designed, developed and incorporated in buildings / facilities (called as sites) to help resultant involvement or swift action to save and protect life.

**About AOEC**

AOEC stands for Akaash Open Enterprise Centre (a Gap analysis and problem solving consultancy) with a team comprising of myself (K.S.Venkatram), Abhiram (Technical consultant and Operations Advisor) and Aakkash K V (BTECH Automotive Engineering).

**## 2. Problem solving (background)**

The Connected Emergency Response Centre framework will need to deploy sense and respond assistants that help use the LifeScores of sites and occupants to procreate & improve the use of art/art form/art work/allied innovation in A-Z assistants that help occupants or responders swiftly act to protect and save life.

The issue being, that occupants at sites differ in their abilities to act at the time of a disaster, threat and/or accelerated risk.

However a CERC department & staff at a site can help design/implement/deploy assistants in a knowledgeable, sufficient, timely and trend sensitive manner to remain Responsive and Socially Accountable to prepare for, address LifeScore differences, sensitize, gather enquiries, resolve queries, requests or issues.

It is also a possible global endeavour and “feeling accountable” vision to transcend the issues of risk mitigation and disaster management that is adept for the ensuing climate change possible in the times to come.

Social accountability for connected emergency response is today more a global risk-mitigator. Can SA8000 be revisited?

A new SA8000-CERC with Social accountability to provide an auditable, voluntary standard, based on CCMA and Connected Emergency Response, to incorporate sense & respond solutions for risk mitigation & disaster management, where the role of the solutions is to sensitize & empower human resources to identify, prepare for and understand a needful response to protect welfare, life & investments.

**## The Learning from Sense and Respond assistants**

The problem on hand is to learn from each assistant’s Sense and Respond experience to identify/improve the “trainable qualified-product-experiences” and the “trainable qualified-product-information” for the assistant.

A. Trainable qualified-product-experiences for an assistant are:

**A.1. Evaluation of Critical Path Method for Emergency Management**

[ 1] Relevant [2] Good [3] Adverse impact [4] Not applicable

**A.2. Evaluation of Critical Path Method for Behavioral Health**

[ 1] Relevant [2] Good [3] Adverse impact [4] Not applicable

**A.3. Evaluation of Critical Path Method for Public Health**

[ 1] Relevant [2] Good [3] Adverse impact [4] Not applicable

**A.4. Evaluation of Critical Path Method for First Responders**

[ 1] Relevant [2] Good [3] Adverse impact [4] Not applicable

**A.5. Evaluation of Critical Path Method for Ambulatory Care**

[ 1] Relevant [2] Good [3] Adverse impact [4] Not applicable

**A.6. Evaluation of mitigating or managing LifeScore dynamics**

[ 1] Relevant [2] Good [3] Adverse impact [4] Not applicable

B. Trainable qualified-product-information for an assistant are:

**B.1. Evaluation of Real Time Score for**

**[A] Guidelines for Connected Emergency Response**

[ 1] Relevant [2] Good [3] Adverse impact [4] Not applicable

**[ B] Impact reduction for Connected Emergency Response**

[1] Relevant [2] Good [3] Adverse impact [4] Not applicable

**[C] Positive health and wellness**

[1] Relevant [2] Good [3] Adverse impact [4] Not applicable

**[D] Better chances of survival for Connected Emergency Response**

[1] Relevant [2] Good [3] Adverse impact [4] Not applicable

**B.2. Evaluation of Interactive factors that help**

**[A] Remembering the Sense & Respond Intent/System for CERC**

[ 1] Relevant [2] Good [3] Adverse impact [4] Not applicable

**[B] Making sense of the Sense & Respond Intent/System for CERC**

[ 1] Relevant [2] Good [3] Adverse impact [4] Not applicable

**[C] Understanding the Sense & Respond Intent/System for CERC**

[1] Relevant [2] Good [3] Adverse impact [4] Not applicable

**[D] Application of the Sense & Respond Intent/System for CERC**

[ 1] Relevant [2] Good [3] Adverse impact [4] Not applicable

**B.3 Evaluation of Process-oriented factors that help the**

**[A] Anytime need to use this assistant / innovation for CERC**

[ 1] Relevant [2] Good [3] Adverse impact [4] Not applicable

**[B] Anywhere use of this assistant / innovation for CERC**

[ 1] Relevant [2] Good [3] Adverse impact [4] Not applicable

**[C] Anyhow use of this assistant / innovation for CERC**

[1] Relevant [2] Good [3] Adverse impact [4] Not applicable

**[D] Zero-unplanned effort use of this assistant / innovation for CERC**

[ 1] Relevant [2] Good [3] Adverse impact [4] Not applicable

**B.4. Evaluation of Performance factors that help the**

**[A] Social Performance / Trust Level for the Occupants**

[ 1] Relevant [2] Good [3] Adverse impact [4] Not applicable

**[B] Social Performance / Trust Level for the CERC team**

[ 1] Relevant [2] Good [3] Adverse impact [4] Not applicable

**[C] Social Performance / Trust Level for First Responders / Special-assistance Responders**

[1] Relevant [2] Good [3] Adverse impact [4] Not applicable

**[D] Social Performance / Trust Level for Construction & Building experts / associated governing authorities**

[ 1] Relevant [2] Good [3] Adverse impact [4] Not applicable

**B.5. Evaluation of Environment factors that help**

**[A] Site specific A-Z Portfolio** **for CERC**

[ 1] Relevant [2] Good [3] Adverse impact [4] Not applicable

**[B] Timeline for responsiveness and Deployment for CERC**

[ 1] Relevant [2] Good [3] Adverse impact [4] Not applicable

**[C] Strategy for sensors, systems, processes, services or remedial steps for CERC**

[1] Relevant [2] Good [3] Adverse impact [4] Not applicable

[**D] Develop responsiveness via a Design-Bid-Build option, or a Design-Build option or a Construction Management** option

[ 1] Relevant [2] Good [3] Adverse impact [4] Not applicable

**## 3. What it does (Solution and Approach)**

**The CERLT-S and its tools implement / improve Bio-centrism for Connected Emergency Response by**

**[a] Creative Adversial Network solutions (with Immersive & Perceptive Time Series Forecasting) for the Real Time Score, Interactive factors**

**[b] Generative Adversial Network solutions (with Objective Reality Recommendation engine) for the Process-oriented factors, Performance factors**

**[c] Convolutional Network solutions (with Strategic Connect Feature extraction) for Green Globe responsiveness**

**[d] Future CERC solutions (with Classification or Supervised Learning) for the Environment factors**

**## 4. Inference**

**The solution involves implementation / improvement of Bio-centrism for Connected Emergency** **Response.**

**For a case study in this hackathon we consider an assistant for an** Emergency Exit/Exit/associated stairway**, where** LifeScore dynamics of the ability of occupants could relate to “not being to run

steadily or fast, not being able to use, assist or clasp with hands firmly, not being able to walk down steps/not being able to climb steps easily, not being well to accomplish emergency response, needing to be assisted in mobility, being pregnant, needing to carry a baby, or child or known aged person”. We term this as **Equity Level in Biocentrism.**

The lack of Biocentrism in the Emergency Exit/Exit/associated stairway could be addressed via Green Globe or LifeScore codification, a Response strategist and Made-to-assist codes that need to be incorporated in the assistant for these pre-requisites and Equity level.

**## 5. Methodology**

In the solution,

1. The Green Globe codifications in the repository are clustered using a combination of

(a) **Text-analytics** of “text fields” with select assistant names / descriptions,

(b) **“trainable qualified-product-experiences” for the assistants,**

**(c) “trainable qualified-product-information” for the assistants and**

(d) **a categorization variable** that categorizes the nature of sense and respond assistance, that is whether **Visual, Auditory and/or Tactile or Some other Sense and Respond experience.**

2. The Text-analytics technique is based on **Word2Vector**

3. The clustering technique is based on **DBSCAN**

4. The **Cosine similarity algorithm** is used to classify sense and respond experiences to fit within one of the buckets created (where this is based on text categorization)

**Work in progress**

**## 6. How we will build it**

We at AOEC are developing the idea using the Python & Anaconda framework and different libraries for Neural networks, data analysis, array processing, Natural language processing, Text-analytics & clustering, visualizing of clusters, **sense and respond assistance** description similarity

**## The details of the libraries follow:**

Specific libraries to load data, perform computation and display output are

(a) Pandas – Data acquisition library

(b) numpy – Array processing library

(c) nltk.data and nltk.corpus – Natural language processing library

(d) gensim and gensim.models – for text analytics and clustering, where the Word2Vector function is used

(e) gensim.models.keyedvectors – to import keyed vectors

(f) matplotlib – for visualizing clusters

(g) sklearn.cluster – to import DBSCAN for clustering

(h) sklearn.metrics.pairwise – to import cosine-similarity to find out sense and respond assistance description similarity

**Work in progress**

**## Code snippets in the basic proof of concept (step wise)**

(1) To import libraries and functions

(2) To load data

(3) For filtering of requests based on assistant groups for “sense and respond assistance categorization” (where there are multiple assistant groups and one CERC Hub category, it is noted that the CERC Hub category is a proof of concept that proposes to help Connected Emergency Response problem solving and adept solution finding

(4) Text analytics to create the training data for the machine learning algorithm

(5) Running of the clustering function

(6) Assigning of a new sense and respond assistance request to a correct bucket based on the cosine-similarity function

**Work in progress**

**## 7. Challenges we ran into**

There are many needs for occupants and responders to act swiftly to help protect and save life/investment at the time of a disaster, threat and/or accelerated risk.

So we need to categorize sense and respond assistance based on LifeScores of sites/occupants, need for disaster readiness, mitigation, responsiveness and recovery via anytime, anywhere, anyhow, zero unplanned effort and emergent assistance, impact reduction, automation and control systems technique, where we review a real-world example for the same, that is the **assistant for an** Emergency Exit/Exit/associated stairway.

**## 8. Accomplishments that we're proud of**

Application of real-world illustrations for an Emergency Exit/ Exit/associated stairway assistant in a Connected Emergency Response Learning Team Suite (promo) that we intend to design further.

**## 9. What we learned (Conclusion)**

Machine Learning Algorithms help us use past understanding or today's details to ideate and enable solutions for corresponding or standardized resolution, where machine learning can quicken problem solving and solution finding.

**## 10. Future Scope**

Building more scope, intelligence and functionality in CERC(s) and Hub analytics to design more sense & respond assistance, intelligence and ensure continual improvement in disaster readiness, mitigation, responsiveness and recovery via A-Z (CERC) assistance, impact reduction, automation and machine learning for

1. Emergency Management

2. Behavioral Health

3. Public Health

4. First Responders

5. Ambulatory Care

6. Connected Emergency Response Analysis for A-Z assistants

**## 11. What's next for Connected Emergency Response Learning Team-Suite (CERLT-S)**

We will take the next steps in **designing a more multi-purpose Connected Emergency Response Learning Team Suite (CERLT-S)**.

We will **use and elevate this fundamental concept in a Connected Emergency Response Centre**, in a **solution deployment level,** that helps sites and occupants mitigate the current “complexity/ risk/crisis” in sensing and responding to disasters, threats and/or accelerated risks.

**## 12. Code Snippet Details (only a basic proof of concept for a CERC tool that clusters / trains sense and respond assistance instances at a site)**

**12.1 To import libraries and functions**

import os

import pandas as pd

import numpy as np

from numpy import array

from IPython.display import display

#For natural language processing ability

import nltk.data

from nltk.corpus import stopwords

#gensim libraries

import gensim

from gensim.models import word2vec

from gensim.models.keyedvectors import KeyedVectors

#to visualize the clusters

import matplotlib.pyplot as plt

import matplotlib.cm as cm

#for clustering

from sklearn.cluster import DBSCAN

import sklearn.metrics as metrics

#to compute service request description similarity

from sklearn.metrics.pairwise import cosine\_similarity

**12.2 To load data**

**The algorithm** will be based on the source of data for the CERC tools / CERLT-S, where this can be a spreadsheet, a .CSV dump of sense and respond assistance, or direct customized access to a CERLT-S database.

The interest is to load the data into the program as an array of strings.

The structure of the .CSV data file for example is

**SRA\_number sense\_and\_respond\_assistance CERC\_group**

*SRA30000 Site LifeScore CERC\_Hub*

*SRA32000 Site SA8000-CERC CERC\_Hub*

*SRA34000 Site* Made-to-assist codes *CERC\_Hub*

*SRA36000 Site* Occupant LifeScores *CER\_ Hub*

SRA40000 Emergency Exit Site\_CERC\_Assistant\_E1

SRA41000 Exit Site\_CERC\_Assistant\_E2

SRA42000 Associated stairway Site\_CERC\_Assistant\_S

SRA50000 Emergency Management Site\_CERC\_CPM\_1

SRA51000 Behavioral Health Site\_CERC\_CPM\_2

SRA52000 Public Health Site\_CERC\_CPM\_3

SRA60000 First Responders Site\_CERC\_CPM\_4

SRA61000 Ambulatory Care Site\_CERC\_CPM\_5

SRA62000 Connected Emergency Response Analysis Site\_CERC\_CPM\_6

... ... ...

**Code snippet**

#data file that contains old sense and respond assistance details

f = ‘old\_sense\_and\_respond\_assistance.xlsx’

data\_1 = pd.read\_excel (f, sheet\_name=’SRA’, converters={‘sense\_and\_respond\_assistance’:str})

**12.3 For filtering of requests based on groups for “sense and respond assistance”**

**The algorithm** will be based on identifying the information from the data set to make sense and respond assistance categorization or clustering easy. For this example, we will use the CERC group or department to be the driver element for the clustering. The details are as follows

{‘*CERC\_Hub’*,

‘Site\_CERC\_Assistant\_E1’,

‘Site\_CERC\_Assistant\_E2’,

‘Site\_CERC\_Assistant\_S’,

‘Site\_CERC\_CPM\_1’,

‘Site\_CERC\_CPM\_2’,

‘Site\_CERC\_CPM\_3’,

‘Site\_CERC\_CPM\_4’,

‘Site\_CERC\_CPM\_5’,

‘Site\_CERC\_CPM\_6’}

**Code snippet**

assignment\_group\_subset = {

‘*CERC\_Hub’*,

‘Site\_CERC\_Assistant\_E1’,

‘Site\_CERC\_Assistant\_E2’,

‘Site\_CERC\_Assistant\_S’,

‘Site\_CERC\_CPM\_1’,

‘Site\_CERC\_CPM\_2’,

‘Site\_CERC\_CPM\_3’,

‘Site\_CERC\_CPM\_4’,

‘Site\_CERC\_CPM\_5’,

‘Site\_CERC\_CPM\_6’}

}

data\_1 = data\_1[data\_1.assignment\_group.isin(assignment\_group\_subset)]

**12.4 Text analytics to create the training data for the machine learning algorithm**

**The algorithm**

1. Create training data by averaging vectors for the words in the Sense and respond assistance (SRA)

2. Calculate the average feature vector for each element and return a 2D numpy array

3. This array is the training data for running cluster functions

**Code snippet**

#Load Google’s pre-trained Word2Vec model known to contain 300 dimensioned vectors for # 3 million words and phrases, this is still in a point of (work in progress) evaluation

model\_google3M = gensim.models.KeyedVectors.load\_word2vec\_format('./GoogleNews-vectors-negative300.bin', binary=True)

#Create training data by averaging vectors for words in the sense\_and\_respond\_assistance #column

def createFeatureVec(words, model, num\_features):

#convert Index2word list to a set for speedy execution

index2word\_set = set (model.wv.index2word)

#loop over each word in the sense\_and\_respond\_assistance

#if it is in the model’s vocabulary, add its feature vector to the total

for word in words:

if word in index2word\_set:

nwords = nwords + 1.

featureVec = np.add ( feastureVec, model[word])

#divide the result by the number of words to get the average

featureVec = np.divide(featureVec, nwords)

return featureVec

def getAvgFeatureVecs(vShortDescription\_s, model, num\_features):

#for the given set of vShortDescription calculate the average feature vector for each list of #words and return a 2D numpy array

counter = 0

#preallocate a 2D numpy array for speed in execution

vShortDescriptionVecs = np.zeros((len(vShortDescription\_s), num\_features), dbtpe = 'float32')

for vShortDescription in vShortDescription\_s:

vShortDescriptionVecs[int(counter)] = createFeatureVec(vShortDescription, model, num\_features)

counter = counter + 1.

return vShortDescriptionVecs

clustering\_vec = getAvgFeatureVecs(data\_1[‘sense\_and\_respond\_assistance’], model\_google3M, 300)

**12.5 Running of the clustering function**

**The algorithm** uses DBSCAN for clustering, which uses a high-density clustering approach. The positions of the vectors created in 12.4 are checked and high-density areas are taken as a new cluster, where low density areas separate clusters

**Code snippets**

#clustering using DBSCAN

db = DBSCAN(eps=0.3, min\_samples = 10).fit(clustering\_vec)

core\_samples\_mask = np.zeros\_like(db.labels\_, dtype=bool)

core\_samples\_mask[db.core\_sample\_indices\_] = True

labels = db.labels\_

**Visualizing the Clustering output**

#plot result

unique\_labels = set (labels)

colors = [plt.cm.Spectral(each)

for each in np.linpace(0,1,len(unique\_labels))]

for k, col in zip (unique\_labels, colors):

if k == -1:

#use black for noise aspect

col = [0,0,0,1]

class\_member\_mask = (labels == k)

xy = clustering\_vec[class\_member\_mask & core\_samples\_mask]

plt.plot(xy.iloc[:,0], xy.iloc[:,1], ‘o’, markerfacecolor = tuple(col), markeredgecolor = ‘k’, makersize = 14)

xy = clustering\_vec[class\_member\_mask & core\_samples\_mask]

plt.plot(xy.iloc[:,0], xy.iloc[:,1], ‘o’, markerfacecolor = tuple(col), markeredgecolor = ‘k’, makersize = 1)

plt.title(‘CERLT-S Estimated number of clusters: %d’ %n\_clusters\_)

plt.show()

**12.6 Assigning of a new sense and respond assistance to a correct bucket based on the cosine-similarity function**

**The Algorithm used**

1. Create the vector from the description text of the Sense and respond assistance (SRA) using the Word2Vec function

2. Calculate the similarity score for the vector using the cosine\_similarity function

3. Find the cluster that the Sense and respond assistance is assigned to where this is done based on the maximum similarity score and averaged across all Sense and respond assistance in the cluster

4. If no matching cluster is found for a Sense and respond assistance vector then the Sense and respond assistance has no training detail in the repository and hence is unassigned for any clustering

**Code snippets**

**#Function assigns a new Sense and respond assistance to previously grouped Sense and respond assistance clusters**

def newSRAClusterer(newSRAText):

#vectorize SRAText

newSRAVector = getAvgFeatureVecs (newSRAText, model\_google3M, 300)

#Build the data frame with Sense and respond assitance meta data and similarity scores

data\_8 = pd.concat ([pd.DataFrame(labels), data\_6\_1[[‘SRA\_number’,sense\_and\_respond\_assistance’,

‘CERC\_group’]]], axis=1)

data\_8.rename (columns = {0:’Cluster’},inplace = True)

data\_8[‘similarityScore’] = cosine\_similarity(data\_6\_1.iloc[:,26:326], newSRAVector)

# Find the cluster that the Sense and respond assistance is assigned to where this is done

# based on the maximum similarity score and averaged across all sense and respond

# assistance in the cluster

similarityScoreMean = data\_8.groupby (‘Cluster’)[‘similarityScore’].mean().max()

newSRACluster = data\_8.groupby (‘Cluster’)[‘similarityScore’].mean().idxmax()

if similarityScoreMean >= 0.7

#this threshold needs to be tuned to ensure noise element is not incorrectly assigned a clustered bucket

print (‘The Sense and respond assistance is assigned to the cluster’, newSRACluster)

print (‘The Sense and respond assistance similarity to the assigned cluster:’, round(similarityScoreMean,2))

else:

print (‘This Sense and respond assistance is unlike any detail in the training repository and is not assigned to any cluster’)

return similarityScoreMean, newSRACluster