Model Development Phase Template

Date	10 July 2024
Team ID	SWTID1720426301
Project Title	**Cognitive Care: Early Intervention For Alzheimer's Disease**
Maximum Marks	10 Marks

Initial Model Training Code, Model Validation and Evaluation Report

The initial model training code will be showcased in the future through a screenshot. The model validation and evaluation report will include a summary and training and validation performance metrics for multiple models, presented through respective screenshots.

Initial Model Training Code :

Xception Model

```
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import SeparableConv2D, BatchNormalization, GlobalAveragePooling2D , Dropout
custom_inception_model = Sequential([
xcep_model,
Dropout(0.5),
GlobalAveragePooling2D(),
Flatten(),
BatchNormalization(),
Dense (512, activation ='relu'),
BatchNormalization(),
Dropout(0.5),
Dense (256, activation ='relu'),
BatchNormalization(),
Dropout(0.5),
Dense (128, activation ='relu'),
BatchNormalization(),
Dropout(0.5),
Dense (64, activation='relu'),
Dropout(0.5),
BatchNormalization(),
Dense(4, activation='softmax')
], name = "inception_cnn_model")
```

```
[10] custom_inception_model.compile(
        loss='categorical_crossentropy',
        optimizer='adam',
        metrics=['accuracy']
    )

history = custom_inception_model.fit(train_data, train_labels, validation_data=(val_data, val_labels), epochs=30)
```

```
xcep_model = Xception(input_shape=IMAGE_SIZE + [3], weights='imagenet', include_top=False)

Downloading data from https://storage.googleapis.com/tensorflow/keras-applications/xception/xception_weights_tf_dim_ordering_tf_kernels_notop.h5
83683744/83683744 [==============================] - 5s 0us/step

[8] for layer in xcep_model.layers:
        layer.trainable = False
```

VGG19 Model

```
[6] from tensorflow.keras.applications import VGG19

    vgg_model = VGG19(weights='imagenet', include_top=False, input_shape=(IMG_SIZE, IMG_SIZE, 3))

Downloading data from https://storage.googleapis.com/tensorflow/keras-applications/vgg19/vgg19_weights_tf_dim_ordering_tf_kernels_notop.h5
80134624/80134624 [==============================] - 4s 0us/step

[7] for layer in vgg_model.layers:
        layer.trainable = False

model = Sequential([
    vgg_model,
    Flatten(),
    Dense(512, activation='relu'),
    Dropout(0.5),
    Dense(256, activation='relu'),
    Dropout(0.5),
    Dense(128, activation='relu'),
    Dropout(0.5),
    Dense(64, activation='relu'),
    Dense(4, activation='softmax')
])
```

```
[9] model.compile(
        optimizer='adam',
        loss='categorical_crossentropy',
        metrics=['accuracy']
    )

history = model.fit(train_data, train_labels, validation_data=(val_data, val_labels), epochs=30)
```

InceptionV3 model

```
from tensorflow.keras.applications import InceptionV3

inception_model = InceptionV3(weights='imagenet', include_top=False, input_shape=(IMG_SIZE, IMG_SIZE, 3))

Downloading data from https://storage.googleapis.com/tensorflow/keras-applications/inception_v3/inception_v3_weights_tf_dim_ordering_tf_kernels_notop.h5
87910968/87910968 [==============================] - 5s 0us/step

[5] for layer in inception_model.layers:
        layer.trainable = False

[6] model = Sequential([
        inception_model,
        Flatten(),
        Dense(512, activation='relu'),
        Dropout(0.5),
        Dense(256, activation='relu'),
        Dropout(0.5),
        Dense(128, activation='relu'),
        Dropout(0.5),
        Dense(64, activation='relu'),
        Dense(4, activation='softmax')
    ])
```

```
[7] model.compile(
        optimizer='adam',
        loss='categorical_crossentropy',
        metrics=['accuracy']
    )

history = model.fit(train_data, train_labels, validation_data=(val_data, val_labels), epochs=30)
```

Model Validation and Evaluation Report :

Model	Summary	Training and Validation Performance Metrics
Xception	Model: "inception_cnn_model" Layer (type) — Output Shape — Param # xception (Functional) — (None, 6, 6, 2048) — 20861480 dropout (Dropout) — (None, 6, 6, 2048) — 0 global_average_pooling2d (GlobalAveragePooling2D) — (None, 2048) — 0 flatten (Flatten) — (None, 2048) — 0 batch_normalization_4 (BatchNormalization) — (None, 2048) — 8192 dense (Dense) — (None, 512) — 1049088 batch_normalization_5 (BatchNormalization) — (None, 512) — 2048 dropout_1 (Dropout) — (None, 512) — 0 dense_1 (Dense) — (None, 256) — 131328 batch_normalization_6 (BatchNormalization) — (None, 256) — 1024 dropout_2 (Dropout) — (None, 256) — 0 dense_2 (Dense) — (None, 128) — 32896 batch_normalization_7 (Bat — (None, 128) — 512 dropout_3 (Dropout) — (None, 128) — 0 dense_3 (Dense) — (None, 64) — 8256 dropout_4 (Dropout) — (None, 64) — 0 batch_normalization_8 (BatchNormalization) — (None, 64) — 256 dense_4 (Dense) — (None, 4) — 260 Total params: 22095340 (84.29 MB) Trainable params: 1227844 (4.68 MB) Non-trainable params: 20867496 (79.60 MB)	Epoch 1/30 205/205 [==========] - 44s 153ms/step - loss: 1.4065 - accuracy: 0.4169 - val_loss: 0.9724 - val_accuracy: 0.5882 Epoch 2/30 205/205 [==========] - 23s 114ms/step - loss: 0.9665 - accuracy: 0.5567 - val_loss: 0.7551 - val_accuracy: 0.6626 Epoch 3/30 205/205 [==========] - 24s 117ms/step - loss: 0.8244 - accuracy: 0.6219 - val_loss: 0.6636 - val_accuracy: 0.6968 Epoch 4/30 205/205 [==========] - 24s 116ms/step - loss: 0.7695 - accuracy: 0.6472 - val_loss: 0.6314 - val_accuracy: 0.7126 Epoch 5/30 205/205 [==========] - 24s 116ms/step - loss: 0.7101 - accuracy: 0.6785 - val_loss: 0.6173 - val_accuracy: 0.7029 Epoch 6/30 205/205 [==========] - 24s 120ms/step - loss: 0.6875 - accuracy: 0.6914 - val_loss: 0.6028 - val_accuracy: 0.7163 Epoch 7/30 205/205 [==========] - 24s 117ms/step - loss: 0.6557 - accuracy: 0.7128 - val_loss: 0.5763 - val_accuracy: 0.7364 Epoch 8/30 205/205 [==========] - 23s 111ms/step - loss: 0.6331 - accuracy: 0.7204 - val_loss: 0.5685 - val_accuracy: 0.7492 Epoch 9/30 205/205 [==========] - 24s 116ms/step - loss: 0.6066 - accuracy: 0.7412 - val_loss: 0.5378 - val_accuracy: 0.7590 Epoch 10/30 205/205 [==========] - 24s 117ms/step - loss: 0.5861 - accuracy: 0.7516 - val_loss: 0.5175 - val_accuracy: 0.7743 Epoch 11/30 205/205 [==========] - 23s 111ms/step - loss: 0.5654 - accuracy: 0.7584 - val_loss: 0.5000 - val_accuracy: 0.7761 Epoch 12/30 205/205 [==========] - 23s 111ms/step - loss: 0.5417 - accuracy: 0.7696 - val_loss: 0.4878 - val_accuracy: 0.7883 Epoch 13/30 205/205 [==========] - 23s 112ms/step - loss: 0.5241 - accuracy: 0.7803 - val_loss: 0.4690 - val_accuracy: 0.7871 Epoch 14/30 205/205 [==========] - 23s 112ms/step - loss: 0.5016 - accuracy: 0.7948 - val_loss: 0.4711 - val_accuracy: 0.8011 Epoch 15/30 205/205 [==========] - 23s 112ms/step - loss: 0.4927 - accuracy: 0.7987 - val_loss: 0.4612 - val_accuracy: 0.7980 Epoch 16/30 205/205 [==========] - 24s 116ms/step - loss: 0.4938 - accuracy: 0.8051 - val_loss: 0.4533 - val_accuracy: 0.8121 Epoch 17/30 205/205 [==========] - 24s 117ms/step - loss: 0.4521 - accuracy: 0.8186 - val_loss: 0.4391 - val_accuracy: 0.8109 Epoch 18/30 205/205 [==========] - 24s 117ms/step - loss: 0.4542 - accuracy: 0.8222 - val_loss: 0.4384 - val_accuracy: 0.8164 Epoch 19/30 205/205 [==========] - 24s 117ms/step - loss: 0.4260 - accuracy: 0.8375 - val_loss: 0.4230 - val_accuracy: 0.8237 Epoch 20/30 205/205 [==========] - 24s 117ms/step - loss: 0.4227 - accuracy: 0.8321 - val_loss: 0.4026 - val_accuracy: 0.8359 Epoch 21/30 205/205 [==========] - 23s 112ms/step - loss: 0.3990 - accuracy: 0.8443 - val_loss: 0.3936 - val_accuracy: 0.8347 Epoch 22/30 205/205 [==========] - 23s 112ms/step - loss: 0.4108 - accuracy: 0.8431 - val_loss: 0.3816 - val_accuracy: 0.8456 Epoch 23/30 205/205 [==========] - 23s 112ms/step - loss: 0.3809 - accuracy: 0.8575 - val_loss: 0.3914 - val_accuracy: 0.8371 Epoch 24/30 205/205 [==========] - 23s 113ms/step - loss: 0.3702 - accuracy: 0.8599 - val_loss: 0.4047 - val_accuracy: 0.8328 Epoch 25/30 205/205 [==========] - 24s 117ms/step - loss: 0.3513 - accuracy: 0.8669 - val_loss: 0.3854 - val_accuracy: 0.8426 Epoch 26/30 205/205 [==========] - 23s 112ms/step - loss: 0.3519 - accuracy: 0.8726 - val_loss: 0.4065 - val_accuracy: 0.8353 Epoch 27/30 205/205 [==========] - 24s 116ms/step - loss: 0.3281 - accuracy: 0.8772 - val_loss: 0.4077 - val_accuracy: 0.8328 Epoch 28/30 205/205 [==========] - 23s 111ms/step - loss: 0.3166 - accuracy: 0.8808 - val_loss: 0.3696 - val_accuracy: 0.8530 Epoch 29/30 205/205 [==========] - 23s 112ms/step - loss: 0.3191 - accuracy: 0.8828 - val_loss: 0.3741 - val_accuracy: 0.8475 Epoch 30/30 205/205 [==========] - 24s 117ms/step - loss: 0.3252 - accuracy: 0.8797 - val_loss: 0.3685 - val_accuracy: 0.8536

VGG19	Model: "sequential" | Layer (type) | Output Shape | Param # | | vgg19 (Functional) | (None, 5, 5, 512) | 20024384 | | flatten (Flatten) | (None, 12800) | 0 | | dense (Dense) | (None, 512) | 6554112 | | dropout (Dropout) | (None, 512) | 0 | | dense_1 (Dense) | (None, 256) | 131328 | | dropout_1 (Dropout) | (None, 256) | 0 | | dense_2 (Dense) | (None, 128) | 32896 | | dropout_2 (Dropout) | (None, 128) | 0 | | dense_3 (Dense) | (None, 64) | 8256 | | dense_4 (Dense) | (None, 4) | 260 | Total params: 26751236 (102.05 MB) Trainable params: 6726852 (25.66 MB) Non-trainable params: 20024384 (76.39 MB)	Epoch 1/30 205/205 [==========] - 48s 182ms/step - loss: 1.5782 - accuracy: 0.2635 - val_loss: 1.3864 - val_accuracy: 0.2508 Epoch 2/30 205/205 [==========] - 27s 134ms/step - loss: 1.3864 - accuracy: 0.2570 - val_loss: 1.3864 - val_accuracy: 0.2495 Epoch 3/30 205/205 [==========] - 28s 136ms/step - loss: 1.3865 - accuracy: 0.2466 - val_loss: 1.3863 - val_accuracy: 0.2495 Epoch 4/30 205/205 [==========] - 28s 135ms/step - loss: 1.3864 - accuracy: 0.2484 - val_loss: 1.3864 - val_accuracy: 0.2495 Epoch 5/30 205/205 [==========] - 28s 135ms/step - loss: 1.3866 - accuracy: 0.2492 - val_loss: 1.3863 - val_accuracy: 0.2502 Epoch 6/30 205/205 [==========] - 28s 135ms/step - loss: 1.3864 - accuracy: 0.2552 - val_loss: 1.3864 - val_accuracy: 0.2495 Epoch 7/30 205/205 [==========] - 28s 135ms/step - loss: 1.3865 - accuracy: 0.2568 - val_loss: 1.3863 - val_accuracy: 0.2502 Epoch 8/30 205/205 [==========] - 32s 159ms/step - loss: 1.3868 - accuracy: 0.2523 - val_loss: 1.3867 - val_accuracy: 0.2508 Epoch 9/30 205/205 [==========] - 33s 159ms/step - loss: 1.3868 - accuracy: 0.2478 - val_loss: 1.3865 - val_accuracy: 0.2502 Epoch 10/30 205/205 [==========] - 28s 136ms/step - loss: 1.3867 - accuracy: 0.2426 - val_loss: 1.3865 - val_accuracy: 0.2502 Epoch 11/30 205/205 [==========] - 33s 159ms/step - loss: 1.3865 - accuracy: 0.2529 - val_loss: 1.3863 - val_accuracy: 0.2508 Epoch 12/30 205/205 [==========] - 33s 159ms/step - loss: 1.3863 - accuracy: 0.2542 - val_loss: 1.3865 - val_accuracy: 0.2495 Epoch 13/30 205/205 [==========] - 28s 136ms/step - loss: 1.3867 - accuracy: 0.2529 - val_loss: 1.3864 - val_accuracy: 0.2495 Epoch 14/30 205/205 [==========] - 32s 159ms/step - loss: 1.3870 - accuracy: 0.2413 - val_loss: 1.3864 - val_accuracy: 0.2495 Epoch 15/30 205/205 [==========] - 33s 159ms/step - loss: 1.3866 - accuracy: 0.2414 - val_loss: 1.3863 - val_accuracy: 0.2495 Epoch 16/30 205/205 [==========] - 33s 159ms/step - loss: 1.3867 - accuracy: 0.2367 - val_loss: 1.3863 - val_accuracy: 0.2495 Epoch 17/30 205/205 [==========] - 33s 160ms/step - loss: 1.3867 - accuracy: 0.2523 - val_loss: 1.3864 - val_accuracy: 0.2495 Epoch 18/30 205/205 [==========] - 28s 137ms/step - loss: 1.3864 - accuracy: 0.2472 - val_loss: 1.3863 - val_accuracy: 0.2495 Epoch 19/30 205/205 [==========] - 28s 136ms/step - loss: 1.3866 - accuracy: 0.2492 - val_loss: 1.3863 - val_accuracy: 0.2502 Epoch 20/30 205/205 [==========] - 28s 136ms/step - loss: 1.3865 - accuracy: 0.2504 - val_loss: 1.3863 - val_accuracy: 0.2495 Epoch 21/30 205/205 [==========] - 28s 135ms/step - loss: 1.3864 - accuracy: 0.2532 - val_loss: 1.3863 - val_accuracy: 0.2502 Epoch 22/30 205/205 [==========] - 33s 159ms/step - loss: 1.3864 - accuracy: 0.2550 - val_loss: 1.3863 - val_accuracy: 0.2495 Epoch 23/30 205/205 [==========] - 33s 159ms/step - loss: 1.3866 - accuracy: 0.2440 - val_loss: 1.3863 - val_accuracy: 0.2495 Epoch 24/30 205/205 [==========] - 33s 160ms/step - loss: 1.3865 - accuracy: 0.2454 - val_loss: 1.3863 - val_accuracy: 0.2495 Epoch 25/30 205/205 [==========] - 28s 136ms/step - loss: 1.3865 - accuracy: 0.2440 - val_loss: 1.3863 - val_accuracy: 0.2495 Epoch 26/30 205/205 [==========] - 33s 161ms/step - loss: 1.3863 - accuracy: 0.2510 - val_loss: 1.3863 - val_accuracy: 0.2495 Epoch 27/30 205/205 [==========] - 28s 137ms/step - loss: 1.3866 - accuracy: 0.2468 - val_loss: 1.3864 - val_accuracy: 0.2495 Epoch 28/30 205/205 [==========] - 33s 160ms/step - loss: 1.3864 - accuracy: 0.2503 - val_loss: 1.3863 - val_accuracy: 0.2495 Epoch 29/30 205/205 [==========] - 33s 159ms/step - loss: 1.3865 - accuracy: 0.2472 - val_loss: 1.3863 - val_accuracy: 0.2495 Epoch 30/30 205/205 [==========] - 33s 159ms/step - loss: 1.3864 - accuracy: 0.2532 - val_loss: 1.3863 - val_accuracy: 0.2495
Inception V3	Model: "sequential" | Layer (type) | Output Shape | Param # | | inception_v3 (Functional) | (None, 4, 4, 2048) | 21802784 | | flatten (Flatten) | (None, 32768) | 0 | | dense (Dense) | (None, 512) | 16777728 | | dropout (Dropout) | (None, 512) | 0 | | dense_1 (Dense) | (None, 256) | 131328 | | dropout_1 (Dropout) | (None, 256) | 0 | | dense_2 (Dense) | (None, 128) | 32896 | | dropout_2 (Dropout) | (None, 128) | 0 | | dense_3 (Dense) | (None, 64) | 8256 | | dense_4 (Dense) | (None, 4) | 260 | Total params: 38753252 (147.83 MB) Trainable params: 16950468 (64.66 MB) Non-trainable params: 21802784 (83.17 MB)	Epoch 1/30 205/205 [==========] - 32s 97ms/step - loss: 4.1756 - accuracy: 0.2550 - val_loss: 1.3861 - val_accuracy: 0.2550 Epoch 2/30 205/205 [==========] - 12s 61ms/step - loss: 1.3880 - accuracy: 0.2420 - val_loss: 1.3856 - val_accuracy: 0.2569 Epoch 3/30 205/205 [==========] - 13s 62ms/step - loss: 1.3851 - accuracy: 0.2425 - val_loss: 1.3789 - val_accuracy: 0.2624 Epoch 4/30 205/205 [==========] - 13s 63ms/step - loss: 1.3879 - accuracy: 0.2480 - val_loss: 1.3863 - val_accuracy: 0.2495 Epoch 5/30 205/205 [==========] - 13s 63ms/step - loss: 1.3865 - accuracy: 0.2490 - val_loss: 1.3864 - val_accuracy: 0.2495 Epoch 6/30 205/205 [==========] - 13s 61ms/step - loss: 1.3866 - accuracy: 0.2448 - val_loss: 1.3863 - val_accuracy: 0.2495 Epoch 7/30 205/205 [==========] - 13s 63ms/step - loss: 1.3865 - accuracy: 0.2428 - val_loss: 1.3863 - val_accuracy: 0.2495 Epoch 8/30 205/205 [==========] - 13s 63ms/step - loss: 1.3864 - accuracy: 0.2442 - val_loss: 1.3865 - val_accuracy: 0.2495 Epoch 9/30 205/205 [==========] - 13s 65ms/step - loss: 1.3865 - accuracy: 0.2509 - val_loss: 1.3864 - val_accuracy: 0.2502 Epoch 10/30 205/205 [==========] - 13s 64ms/step - loss: 1.3864 - accuracy: 0.2429 - val_loss: 1.3863 - val_accuracy: 0.2495 Epoch 11/30 205/205 [==========] - 13s 64ms/step - loss: 1.3865 - accuracy: 0.2417 - val_loss: 1.3864 - val_accuracy: 0.2495 Epoch 12/30 205/205 [==========] - 13s 65ms/step - loss: 1.3865 - accuracy: 0.2468 - val_loss: 1.3864 - val_accuracy: 0.2495 Epoch 13/30 205/205 [==========] - 13s 64ms/step - loss: 1.3864 - accuracy: 0.2529 - val_loss: 1.3864 - val_accuracy: 0.2495 Epoch 14/30 205/205 [==========] - 13s 64ms/step - loss: 1.3864 - accuracy: 0.2489 - val_loss: 1.3863 - val_accuracy: 0.2502 Epoch 15/30 205/205 [==========] - 13s 63ms/step - loss: 1.3866 - accuracy: 0.2457 - val_loss: 1.3863 - val_accuracy: 0.2502 Epoch 16/30 205/205 [==========] - 13s 65ms/step - loss: 1.3863 - accuracy: 0.2477 - val_loss: 1.3864 - val_accuracy: 0.2495 Epoch 17/30 205/205 [==========] - 13s 63ms/step - loss: 1.3863 - accuracy: 0.2524 - val_loss: 1.3864 - val_accuracy: 0.2495 Epoch 18/30 205/205 [==========] - 13s 64ms/step - loss: 1.3864 - accuracy: 0.2489 - val_loss: 1.3864 - val_accuracy: 0.2495 Epoch 19/30 205/205 [==========] - 13s 64ms/step - loss: 1.3864 - accuracy: 0.2472 - val_loss: 1.3863 - val_accuracy: 0.2495 Epoch 20/30 205/205 [==========] - 13s 64ms/step - loss: 1.3864 - accuracy: 0.2483 - val_loss: 1.3863 - val_accuracy: 0.2502 Epoch 21/30 205/205 [==========] - 13s 64ms/step - loss: 1.3867 - accuracy: 0.2371 - val_loss: 1.3863 - val_accuracy: 0.2495 Epoch 22/30 205/205 [==========] - 13s 63ms/step - loss: 1.3865 - accuracy: 0.2463 - val_loss: 1.3864 - val_accuracy: 0.2502 Epoch 23/30 205/205 [==========] - 13s 64ms/step - loss: 1.3867 - accuracy: 0.2446 - val_loss: 1.3863 - val_accuracy: 0.2495 Epoch 24/30 205/205 [==========] - 13s 63ms/step - loss: 1.3866 - accuracy: 0.2524 - val_loss: 1.3863 - val_accuracy: 0.2502 Epoch 25/30 205/205 [==========] - 13s 65ms/step - loss: 1.3864 - accuracy: 0.2408 - val_loss: 1.3863 - val_accuracy: 0.2495 Epoch 26/30 205/205 [==========] - 13s 64ms/step - loss: 1.3865 - accuracy: 0.2483 - val_loss: 1.3864 - val_accuracy: 0.2495 Epoch 27/30 205/205 [==========] - 13s 65ms/step - loss: 1.3866 - accuracy: 0.2407 - val_loss: 1.3863 - val_accuracy: 0.2495 Epoch 28/30 205/205 [==========] - 13s 66ms/step - loss: 1.3866 - accuracy: 0.2455 - val_loss: 1.3864 - val_accuracy: 0.2495 Epoch 29/30 205/205 [==========] - 13s 64ms/step - loss: 1.3862 - accuracy: 0.2556 - val_loss: 1.3864 - val_accuracy: 0.2508 Epoch 30/30 205/205 [==========] - 13s 64ms/step - loss: 1.3866 - accuracy: 0.2439 - val_loss: 1.3864 - val_accuracy: 0.2495