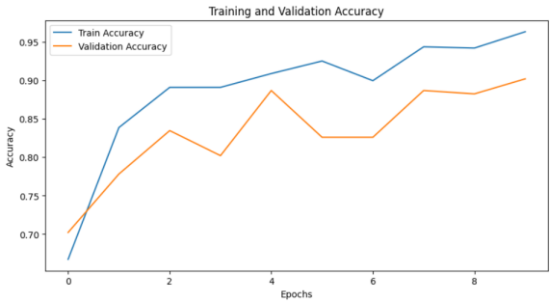
Raport Proiect: Clasificarea Tumorilor Cerebrale din Imagini MRI

Cerinta 1: K-fold cross-validation

```
Fold Test Metrics:
   Fold  Accuracy  Precision    Recall  F1-Score
0     1  0.690355   0.704260  0.690355  0.669004
1     2  0.639594   0.748941  0.639594  0.578489
2     3  0.708122   0.745631  0.708122  0.680464
3     4  0.682741   0.813689  0.682741  0.649013
4     5  0.555838   0.713220  0.555838  0.535677

Mean and StdDev for Test Metrics:
      Metric      Mean    StdDev
0   Accuracy  0.655330  0.054610
1  Precision  0.745148  0.038480
2     Recall  0.655330  0.054610
3   F1-Score  0.622529  0.056037


   Fold  Validation Accuracy Mean  Validation Accuracy StdDev  \
0     1                  0.832826                    0.058506
1     2                  0.877124                    0.054876
2     3                  0.838562                    0.092982
3     4                  0.832898                    0.108452
4     5                  0.837255                    0.050777

   Validation Precision Mean  Validation Precision StdDev  \
0                   0.822962                     0.064687
1                   0.846860                     0.059183
2                   0.823001                     0.065185
3                   0.839849                     0.055340
4                   0.838345                     0.063742

   Validation Recall Mean  Validation Recall StdDev  Validation F1 Mean  \
0                0.823148                  0.064704            0.822799
1                0.846941                  0.059187            0.846771
2                0.822524                  0.066043            0.822360
3                0.839880                  0.055705            0.839747
4                0.838724                  0.063395            0.838454

   Validation F1 StdDev
0              0.065020
1              0.059346
2              0.066096
3              0.055678
4              0.063615
```

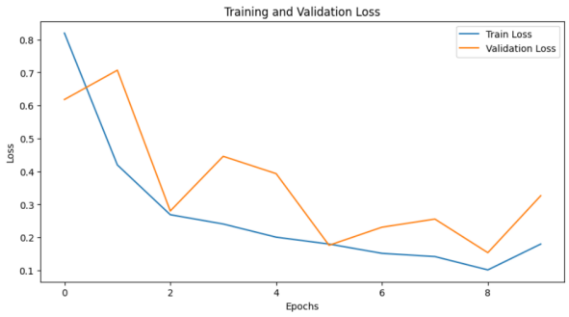
Fold 1:

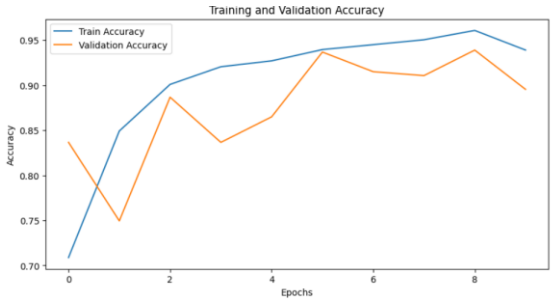
```
Accuracy: 0.6903553299492385
Precision: 0.7042604653976728
Recall: 0.6903553299492385
F1-score: 0.6690041051296811
Performance: 0.8996526002883911
```



Fold 2:

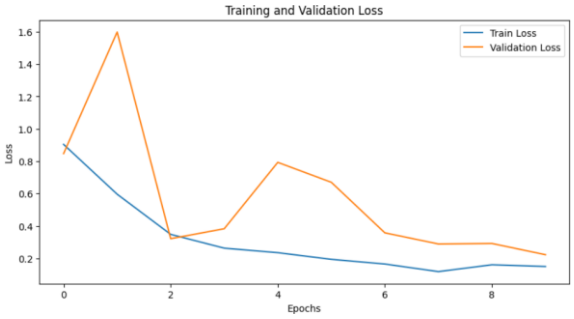
```
Accuracy: 0.6395939086294417
Precision: 0.7489410877658111
Recall: 0.6395939086294417
F1-score: 0.5784892638582098
Performance: 0.8877402544021606
```

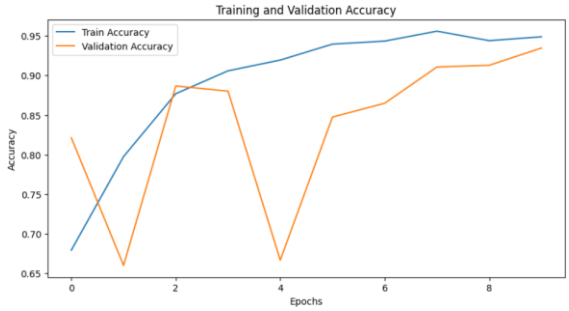




Fold 3:

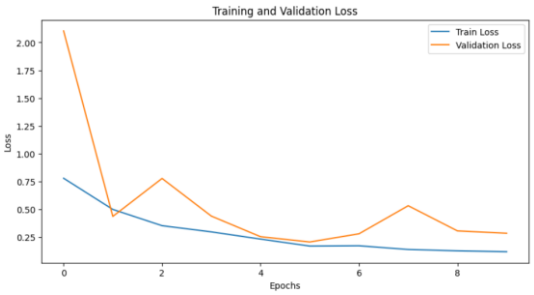
```
Accuracy: 0.7081218274111675
Precision: 0.7456310249709182
Recall: 0.7081218274111675
F1-score: 0.6804643034999295
Performance: 0.9023250937461853
```

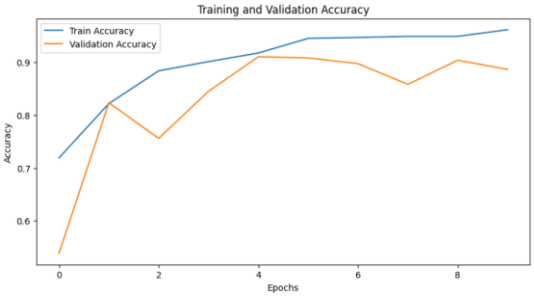




Fold 4:

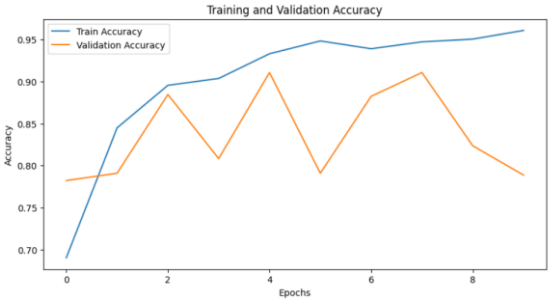
```
Accuracy: 0.682741116751269
Precision: 0.8136892261257743
Recall: 0.682741116751269
F1-score: 0.6490127437768489
Performance: 0.8972537517547607
```





Fold 5:

```
Accuracy: 0.5558375634517766
Precision: 0.7132199010380583
Recall: 0.5558375634517766
F1-score: 0.5356767768677982
Performance: 0.8616282939910889
```



Exista o variabilitate semnificativa intre fold-uri, mai ales in ceea ce priveste acuratetea.

Deviatia standard pentru metrica Accuracy ar putea arata ca exista fluctuatii intre fold-uri, dar nu foarte mari.

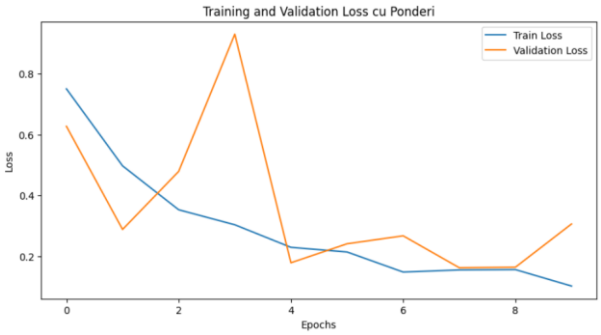
Fold-ul 5 ar putea fi analizat pentru a identifica daca exista date zgomotoase sau dezechilibre care afecteaza performanta, avand o acuratete mai slaba decat celelalte.

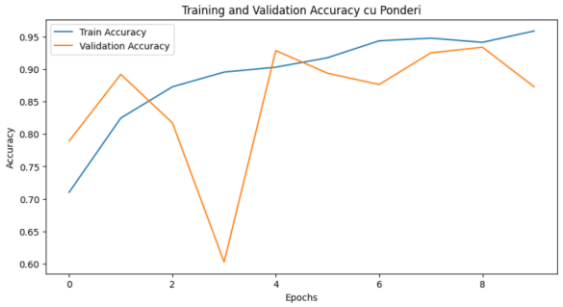
Precizia mai mare pe datele de validare comparativ cu cele de test poate indica un inceput de overfitting.

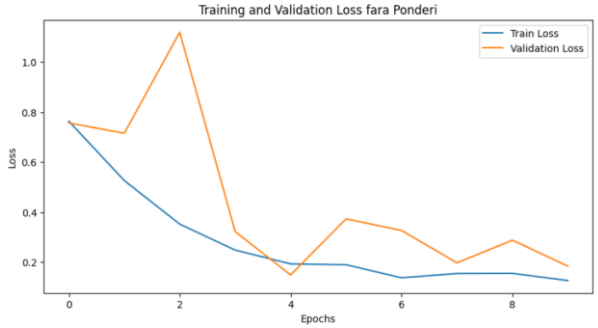
Cerinta 2:

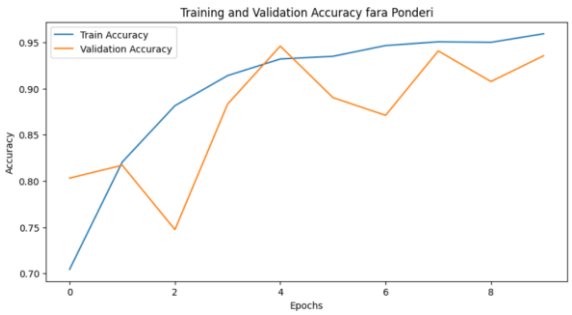
a) Functia de loss cu ponderi

	Metrica	Cu Ponderi	Fara Ponderi
0	performance	0.894105	0.924757
1	accuracy	0.637056	0.753807
2	precision	0.680319	0.760245
3	recall	0.637056	0.753807
4	F1-score	0.584317	0.724167





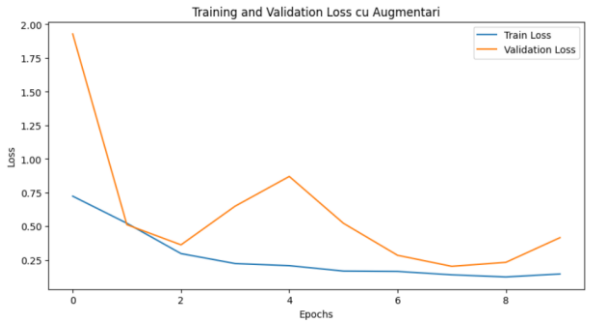


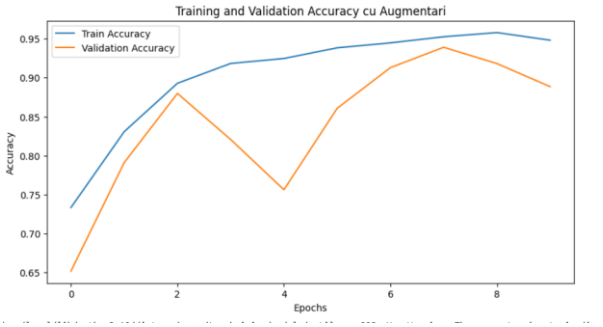


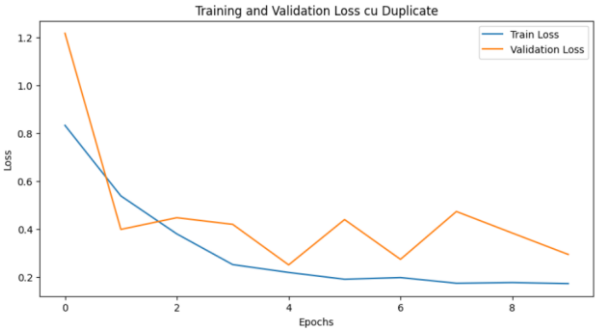
Se observa ca Functia de loss fara ponderi are rezultate putin mai bune.

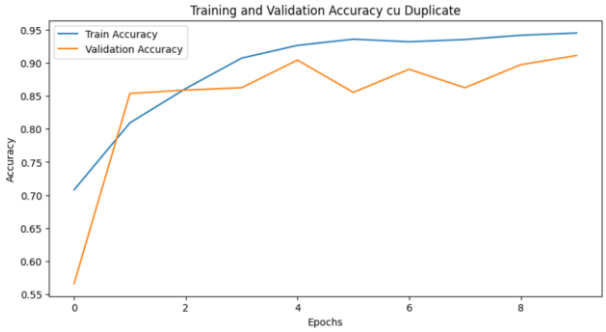
b) Oversampling

	Metrica	Cu Augmentari	Cu Duplicate
0	performance	0.897660	0.919470
1	accuracy	0.662437	0.730964
2	precision	0.740327	0.776587
3	recall	0.662437	0.730964
4	F1-score	0.640794	0.692194









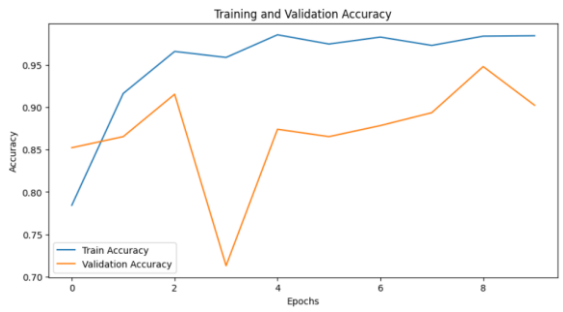
Se observa ca Oversamplingul cu duplicate aduce niste metrici mai bune, lucru care ar putea inseamna ca augmentarile aplicate nu sunt cele mai potrivite.

Cerinta 3:

Setul 1:

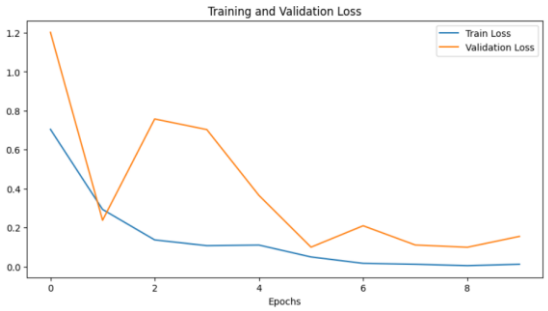
Fold 1:

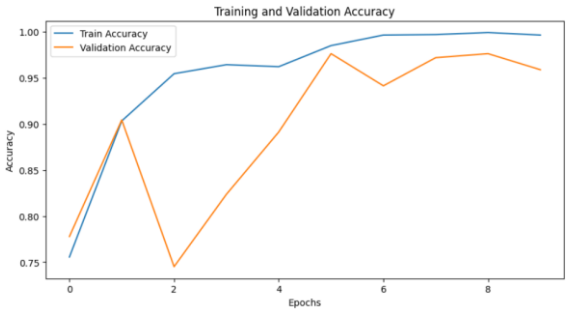
```
Accuracy: 0.799492385786802
Precision: 0.820125154072127
Recall: 0.799492385786802
F1-score: 0.7776987274393011
Performance: 0.935730516910553
```



Fold 2:

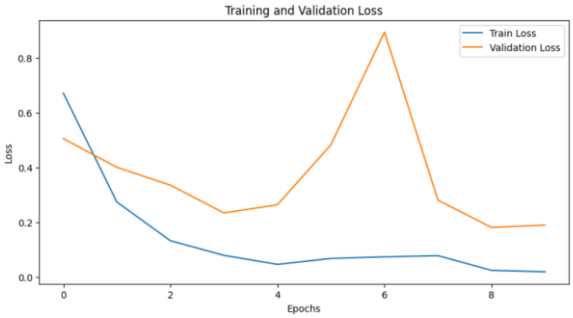
```
Accuracy: 0.7588832487309645
Precision: 0.8171229629505462
Recall: 0.7588832487309645
F1-score: 0.73215979376099
Performance: 0.9322068691253662
```

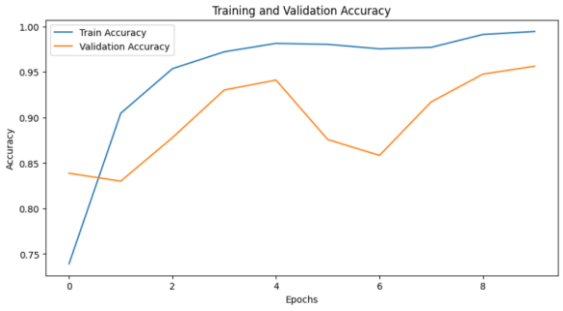




Fold 3:

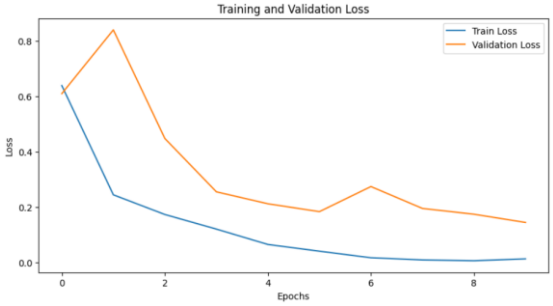
```
Accuracy: 0.733502538071066
Precision: 0.794457502938161
Recall: 0.733502538071066
F1-score: 0.6933838233032023
Performance: 0.9466570615768433
```

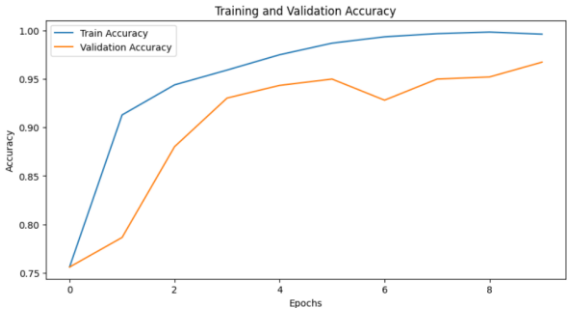




Fold 4:

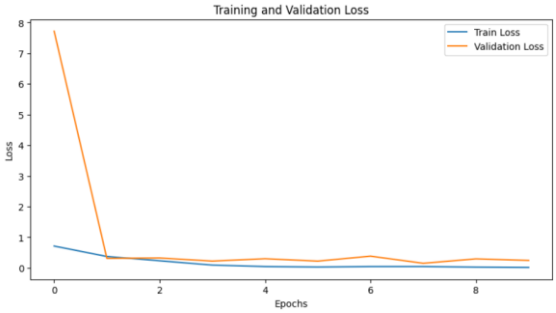
```
Accuracy: 0.7284263959390863
Precision: 0.7925214315132643
Recall: 0.7284263959390863
F1-score: 0.6857137301152598
Performance: 0.9346755743026733
```

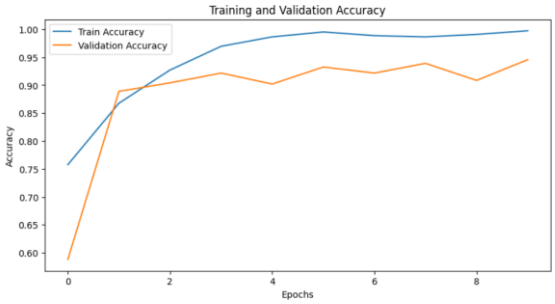




Fold 5:

```
Accuracy: 0.7157360406091371
Precision: 0.7833803272534117
Recall: 0.7157360406091371
F1-score: 0.684995414454678
Performance: 0.926912784576416
```

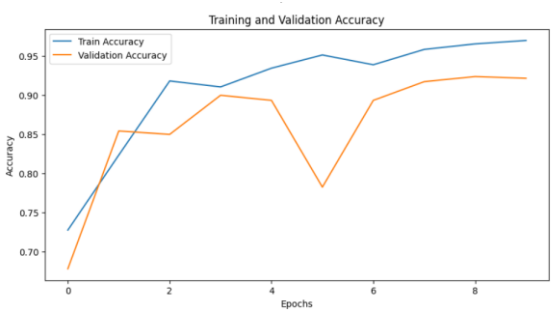




Setul 2:

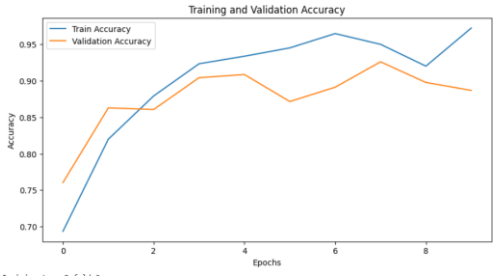
Fold 1:

```
Accuracy: 0.7385786802030457
Precision: 0.7852987343225667
Recall: 0.7385786802030457
F1-score: 0.6978482528310892
Performance: 0.9267093539237976
```



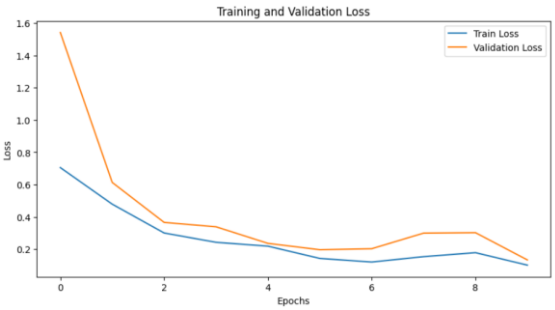
Fold 2:

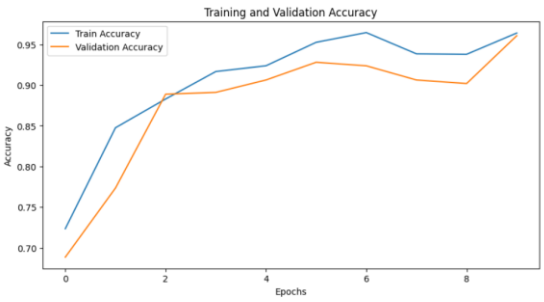
```
Accuracy: 0.7411167512690355
Precision: 0.773585382540378
Recall: 0.7411167512690355
F1-score: 0.7188236706063047
Performance: 0.9148873090744019
```



Fold 3:

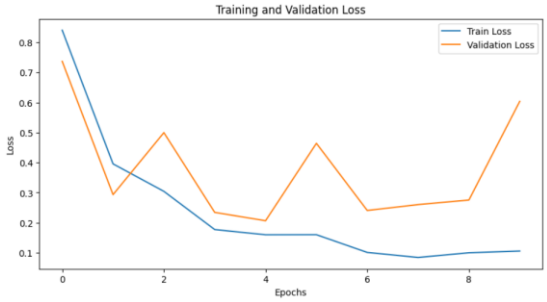
```
Accuracy: 0.6979695431472082
Precision: 0.7839421025527846
Recall: 0.6979695431472082
F1-score: 0.6595816166210441
Performance: 0.9055231213569641
```

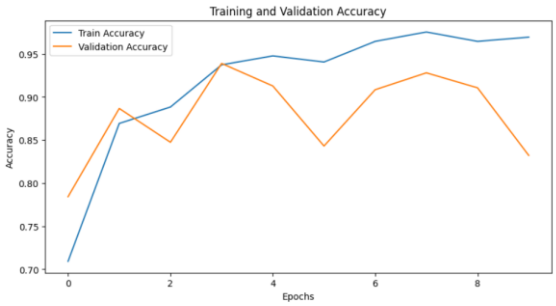




Fold 4:

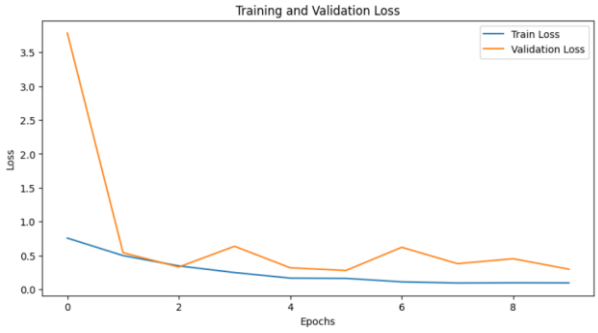
```
Accuracy: 0.682741116751269
Precision: 0.758527989911798
Recall: 0.682741116751269
F1-score: 0.6209047329944395
Performance: 0.8999854922294617
```

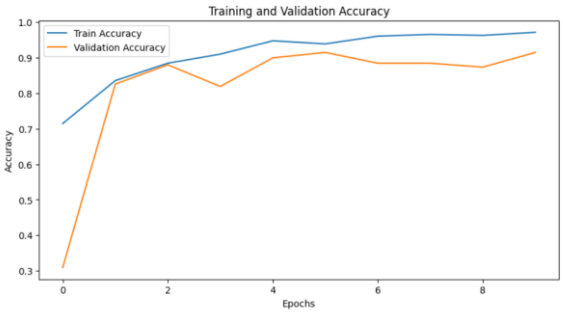




Fold 5:

```
Accuracy: 0.700507614213198
Precision: 0.7680501411760459
Recall: 0.700507614213198
F1-score: 0.6479382210879244
Performance: 0.9032580852508545
```

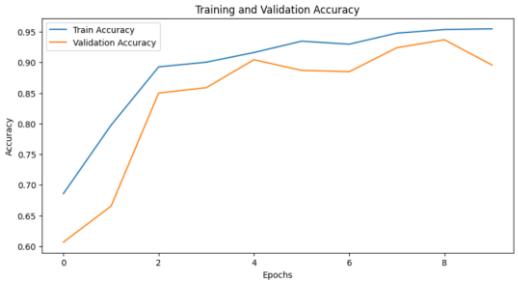




Setul 3:

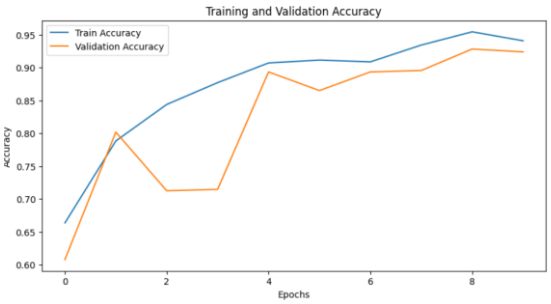
Fold 1:

```
Accuracy: 0.7385786802030457
Precision: 0.7561696441970105
Recall: 0.7385786802030457
F1-score: 0.7191228127777858
Performance: 0.9196098446846008
```



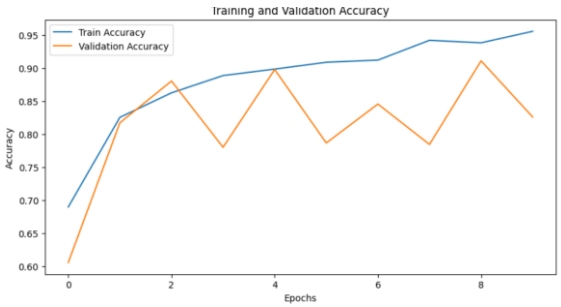
Fold 2:

```
Accuracy: 0.7030456852791879
Precision: 0.760924274068009
Recall: 0.7030456852791879
F1-score: 0.666139401196516
Performance: 0.9072510004043579
```



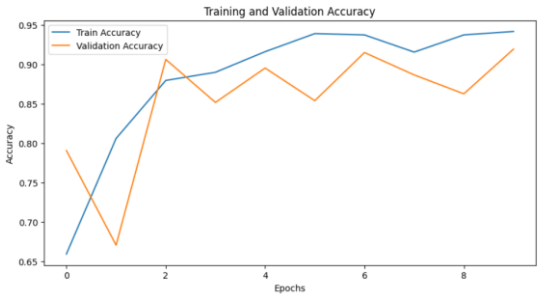
Fold 3:

```
Accuracy: 0.5913705583756346
Precision: 0.7084197601302352
Recall: 0.5913705583756346
F1-score: 0.5806249224843061
Performance: 0.8510314226150513
```



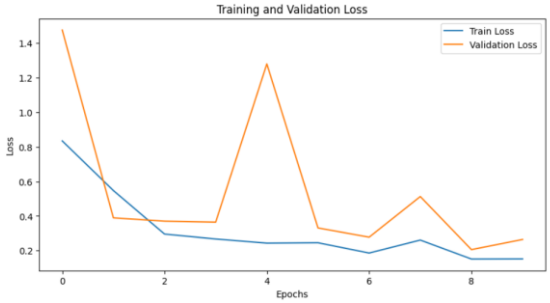
Fold 4:

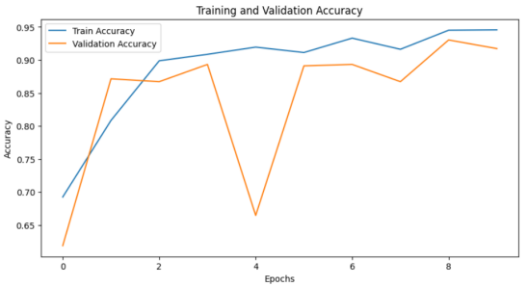
```
Accuracy: 0.7766497461928934
Precision: 0.7802278771189489
Recall: 0.7766497461928934
F1-score: 0.7543732897546057
Performance: 0.9161796569824219
```



Fold 5:

```
Accuracy: 0.7461928934010152
Precision: 0.8037009648788795
Recall: 0.7461928934010152
F1-score: 0.71955508644093
Performance: 0.9172706604003906
```





Valorile medii pentru metrici per setul de date

	Metrici	Set1	Set2	Set3
0	Precision	0.801521	0.773881	0.761889
1	Recall	0.747208	0.712183	0.711168
2	F1-Score	0.714790	0.669019	0.687963
3	AUC	0.935237	0.910073	0.902269

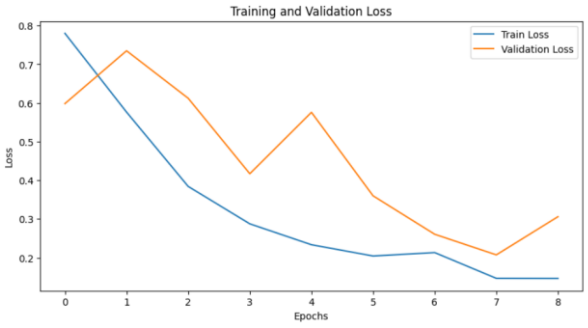
Valorile performantelor per fiecare fold

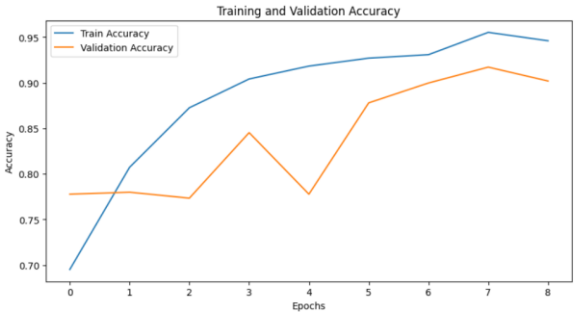
	Fold	Set1	Set2	Set3
0	1	0.935731	0.926709	0.919610
1	2	0.932207	0.914887	0.907251
2	3	0.946657	0.905523	0.851031
3	4	0.934676	0.899985	0.916180
4	5	0.926913	0.903258	0.917271

Se observa ca mai multe transformari aplicate nu inseamna o performanta mai buna a modelului. De fapt, un numar crescut de transformari poate introduce zgomot suplimentar sau poate duce la supraspecializare, afectand negativ capacitatea de generalizare a modelului. Este esential sa se gaseasca un echilibru intre complexitatea transformarilor si eficienta modelului pentru a asigura rezultate optime.

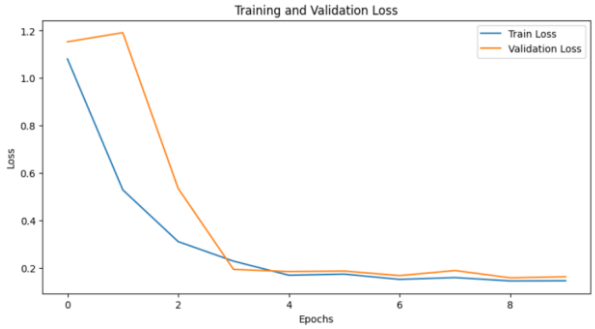
Cerinta 4: **(Foldul testat este cel cu numarul 3, pornind de la 1, pe setul 3 de transformari)**

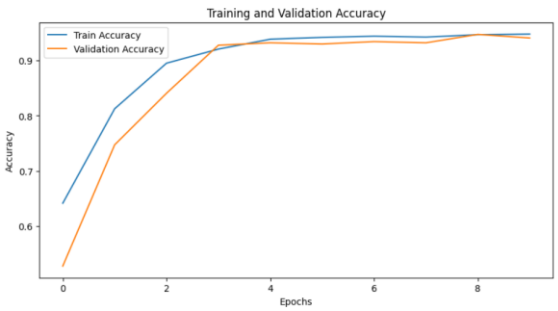
Early Stopping:





StepLR:





Metrici:

	Metrici	Early_Stopping	StepLR
0	Accuracy	0.682741	0.718274
1	Precision	0.703417	0.750338
2	Recall	0.682741	0.718274
3	F1-Score	0.644780	0.692096
4	AUC	0.895239	0.911609
5	TIME_TRAINING	401.763484	414.437661

Comparand cele doua strategii de optimizare, StepLR se dovedeste mai performanta decat Early_Stopping, obtinand valori mai bune pentru toate metricele: acuratete (0.718 fata de 0.682), precizie (0.750 fata de 0.703), recall (0.718 fata de 0.682), F1-score (0.692 fata de 0.644) si AUC (0.911 fata de 0.895). Acest lucru indica un model mai bine calibrat, care face distinctii mai precise intre clase. Desi timpul de antrenare pentru StepLR este putin mai mare (414 secunde fata de 401 secunde), cresterea performantei justifica acest timp suplimentar.