DETEKCIJA OZLJEDA ABDOMENA

IZ CT SLIKA

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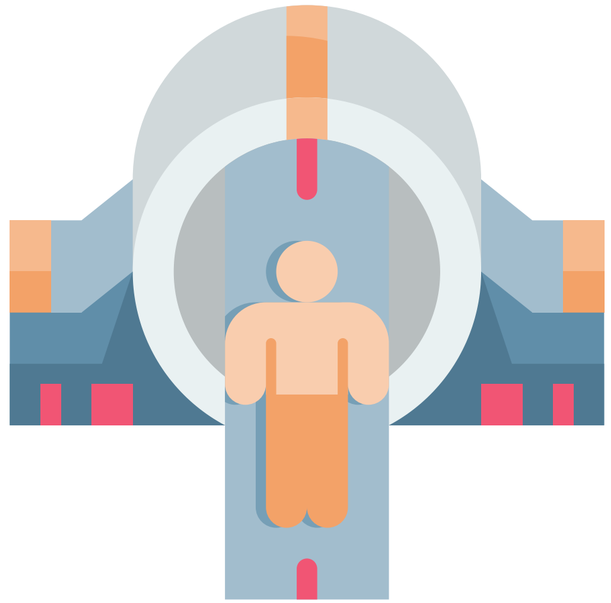
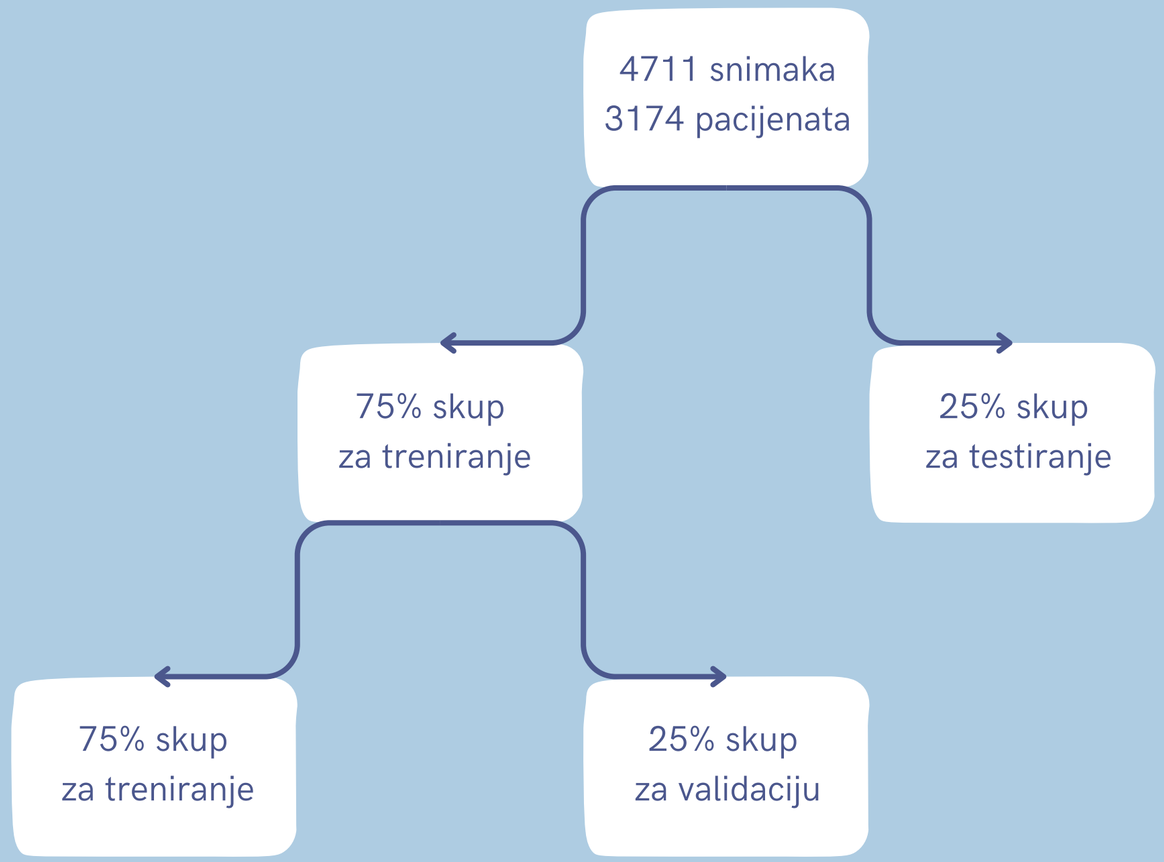
UVOD



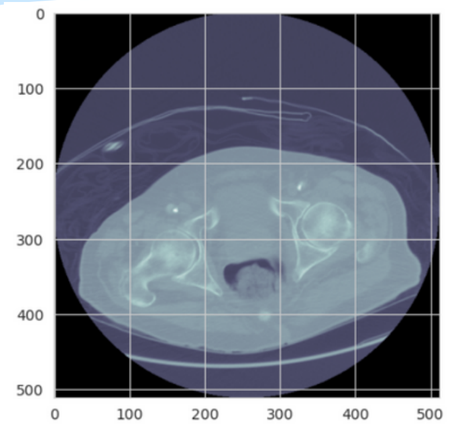
- traumatske ozljede -> najčešći su uzrok smrti u prvih 40 godina života
- abdominalne ozljede često zahtijevaju hitnu kiruršku intervenciju - važna brza dijagnoza
- CT - detaljno i relativno brzo snimanje presjeka abdomena
- primjena strojnog učenja - detekcija ozljeda: unutarnje krvarenje, ozljede crijeva, bubrega, jetre i slezene
- RSNA 2023 Abdominal Trauma Detection AI Challenge

PODACI

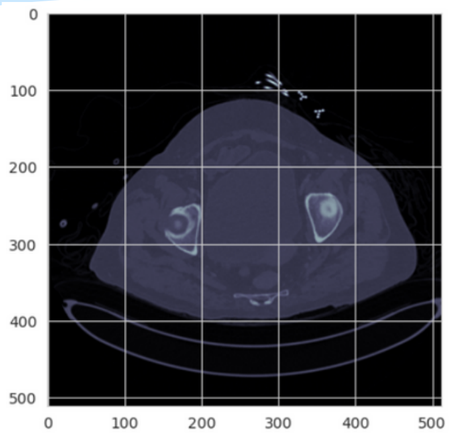


- oznake skupa:
  - binarne oznake za crijeva i unutarnje krvarenje -> 0 = bez ozljede, 1 = ozljeda
  - tri oznake za bubrege, jetru i slezenu-> 0 = bez ozljede, 1 = lakša ozljeda, 2 = teža ozljeda
- pretprocesiranje:
  a. slike u DICOM formatu se pretvaraju u niz vrijednosti piksela u rasponu [0, 1]
  b. primjena transformacija na niz
  c. pretvorba u tenzor
- nebalansiran skup podataka -> malo pozitivnih (ozlijeđenih) primjera (!)

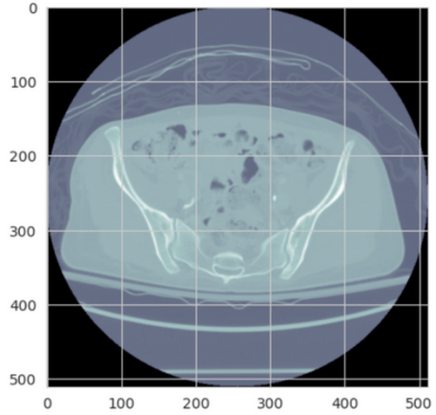
PODACI



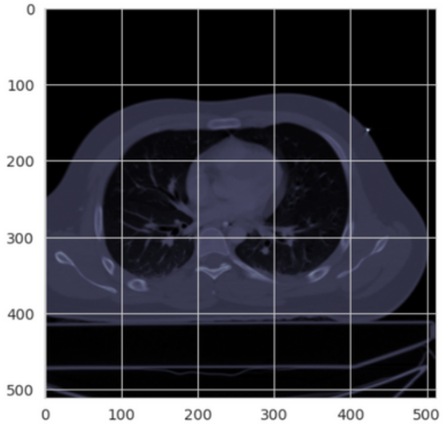
BEZ OZLJEDE



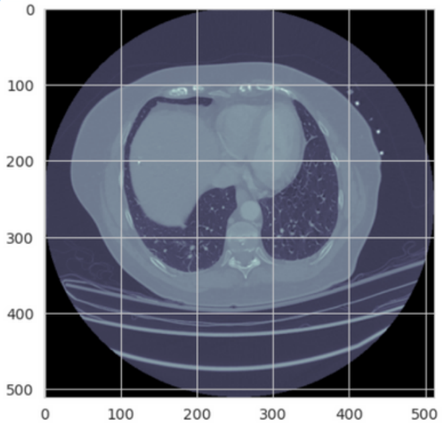
UNUTARNJE KRVARENJE



OZLJEDA CRIJEVA

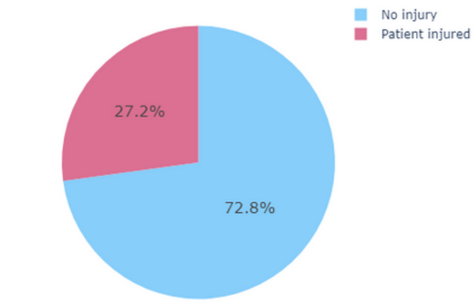


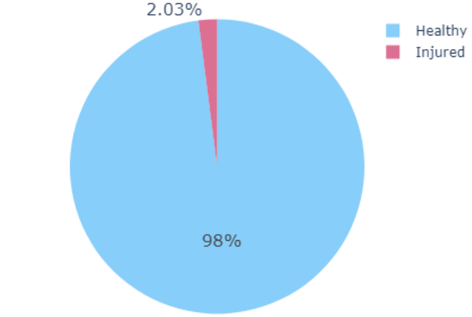
TEŠKA OZLJEDA BUBREGA I JETRE

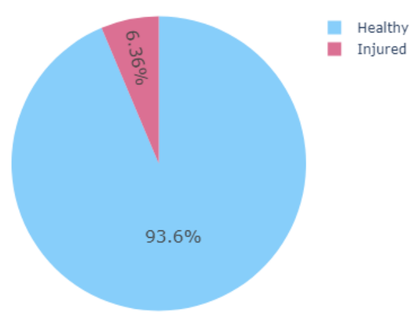


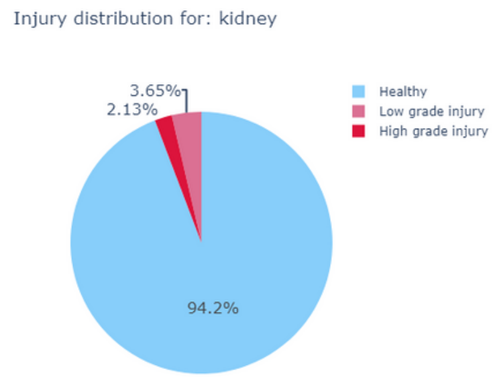
TEŠKA OZLJEDA SLEZENE

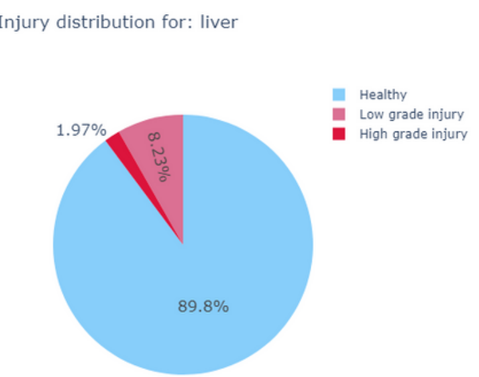
PODACI

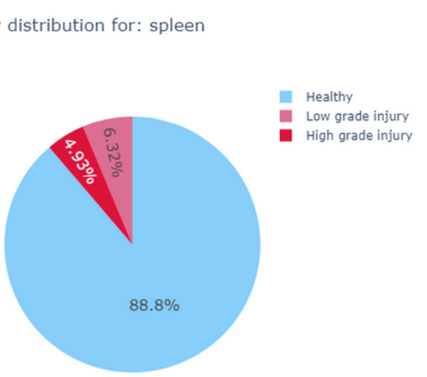

Injuries reported in patients
No injury
Patient injured
27.2%
72.8%


Injury distribution for: bowel
2.03%
Healthy
Injured
98%


Injury distribution for: extravasation
Healthy
Injured
6.36%
93.6%


Injury distribution for: kidney
3.65%
2.13%
Healthy
Low grade injury
High grade injury
94.2%


Injury distribution for: liver
Healthy
Low grade injury
High grade injury
1.97%
8.23%
89.8%


Injury distribution for: spleen
Healthy
Low grade injury
High grade injury
6.32%
4.93%
88.8%

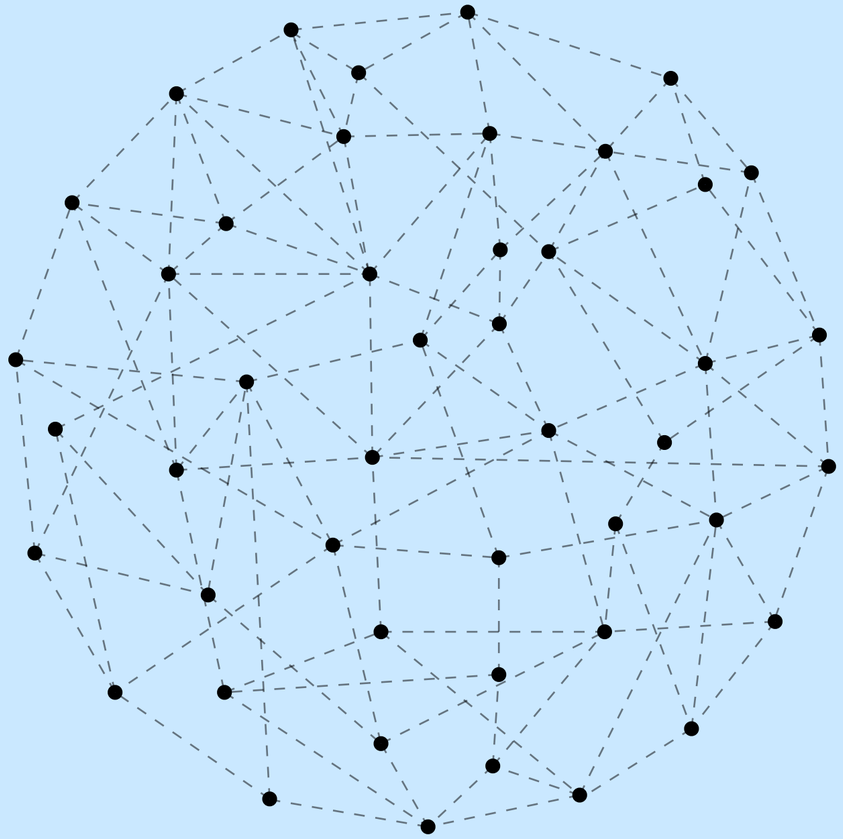
MODEL

```
class CNNModel(nn.Module):
    def __init__(self):
        super().__init__()

        self.input = nn.Conv2d(4, 3, kernel_size = 3)
        model = models.efficientnet_b0(weights = 'IMAGENET1K_V1')

        self.features = model.features
        self.avgpool = model.avgpool

        self.bowel = nn.Linear(1280, 1)
        self.extravasation = nn.Linear(1280, 1)
        self.kidney = nn.Linear(1280, 3)
        self.liver = nn.Linear(1280,3)
        self.spleen = nn.Linear(1280, 3)
```

- CNN model baziran na već istreniranom EfficientNet-B0 modelu
- hiperparametri modela:
  - learning rate = 0.0004, Adam optimizator
  - batch size = 16
  - broj epoha = 12
- gubitak unakrsne entropije

MODEL

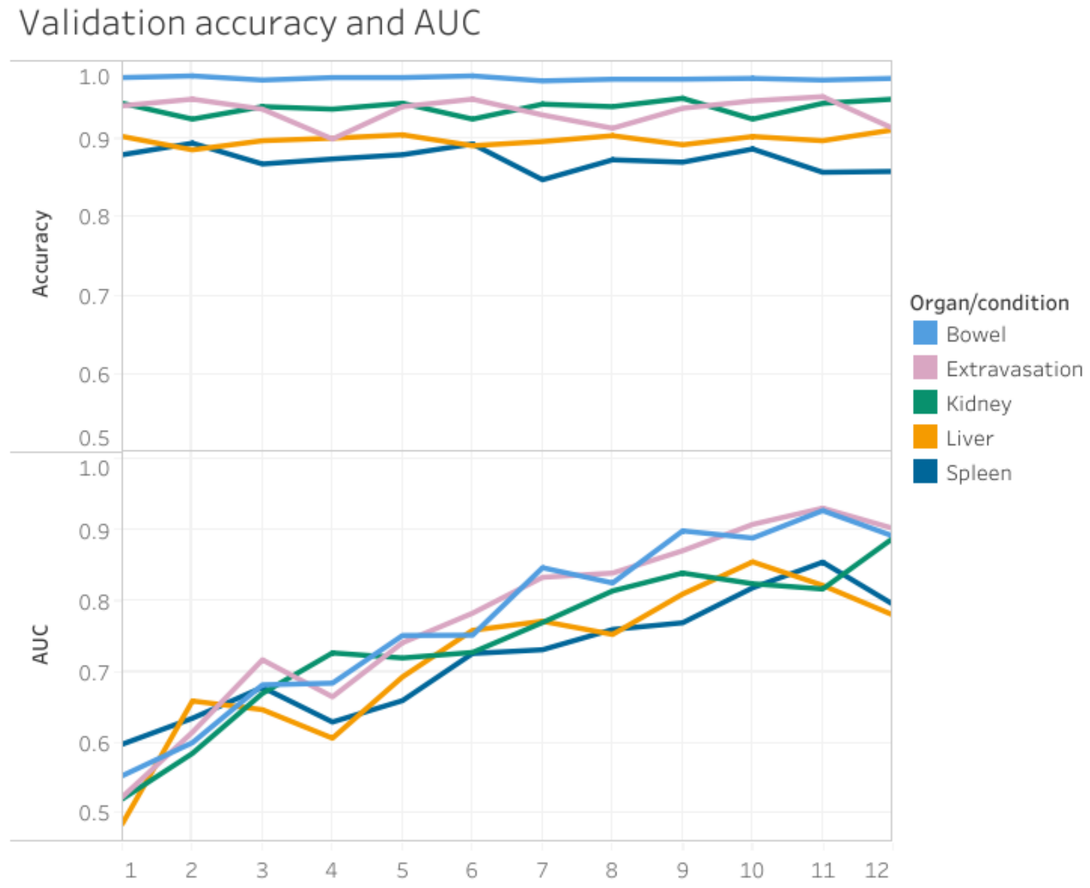
- crijeva i unutarnje krvarenje -> 1 izlazna vrijednost u rasponu [0, 1]
  - [x] – vjerojatnost da postoji ozljeda
- bubrezi, jetra i slezena -> 3 izlazne vrijednosti, svaka u rasponu [0,1]:
  - [a, b, c]
    - a = vjerojatnost da organ nema ozljede
    - b = vjerojatnost da je organ lakše ozlijeđen
    - c = vjerojatnost da je organ teže ozlijeđen
- primjer predviđenih vrijednosti:
  - bowel [0.01] - nema ozljede na crijevima
  - extravasation [0.8] – postoji unutarnje krvarenje
  - kidney [0.1, 0.8, 0.1] – bubreg ima lakšu ozljedu
  - liver [0.9, 0.1, 0.001] – jetra nema ozljedu
  - spleen [0.2, 0.1, 0.7] – slezena ima težu ozljedu



METRIKE

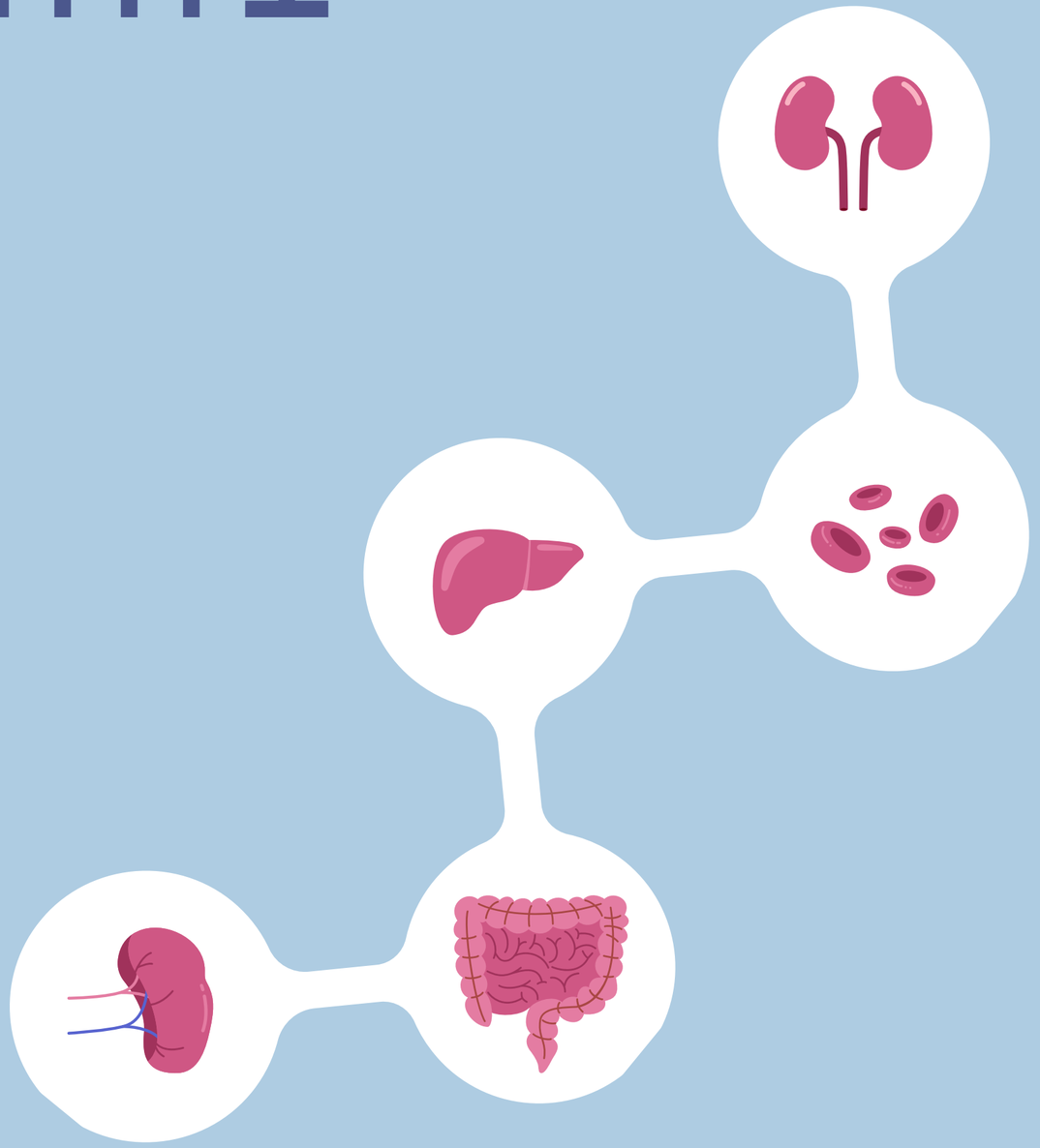
Injury type	Accuracy	AUC
Bowel	0.975584	0.927473
Extravasation	0.954352	0.930937
Liver	0.898089	0.821857
Kidney	0.945860	0.816676
Spleen	0.857749	0.854666

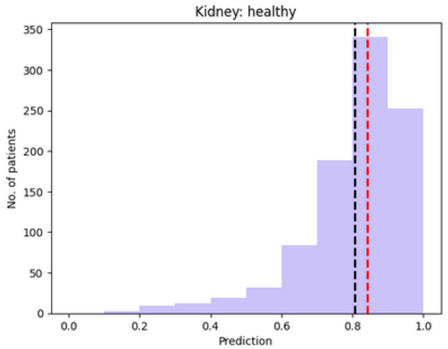
- točnost (accuracy) – nepovoljna zbog prirode skupa podataka (nebalansiran)
- AUC (Area under the ROC Curve) – bolji izbor
- validacija na kraju svake epohe

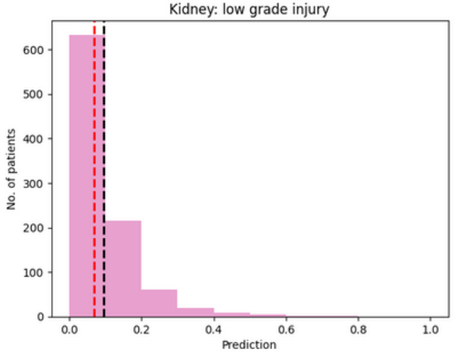


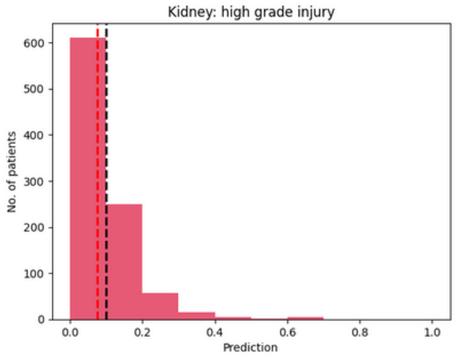
REZULTATI

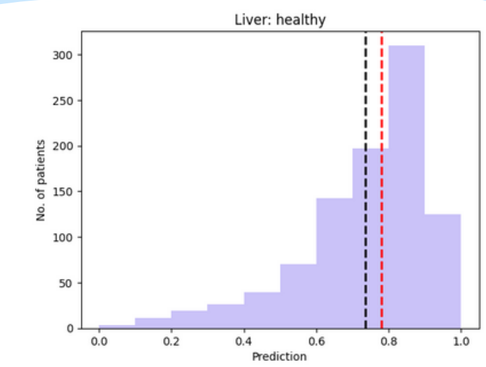
- prikaz predikcija histogramom: zastupljenost vjerojatnosti
  - idealne predikcije što bliže 0 ili 1 - veća sigurnost pri donošenju zaključaka
- zadovoljavajući rezultati
  - najbolje predikcije za crijeva i unutarnje krvarenje
- na većini slika nisu detektirane ozljede
  - u skladu s ulaznim podacima

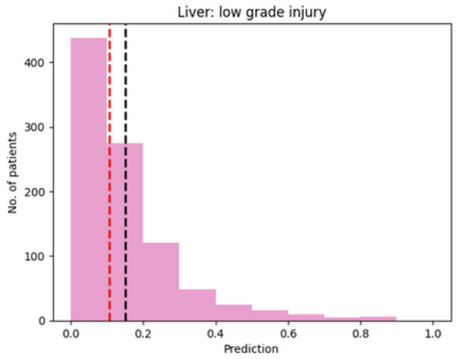


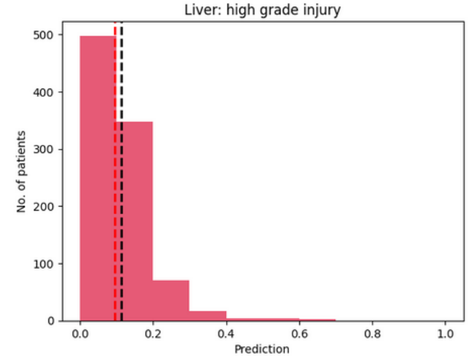

Kidney: healthy
No. of patients
Prediction

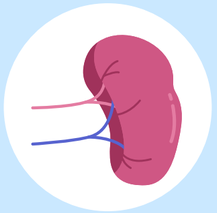

Kidney: low grade injury
No. of patients
Prediction

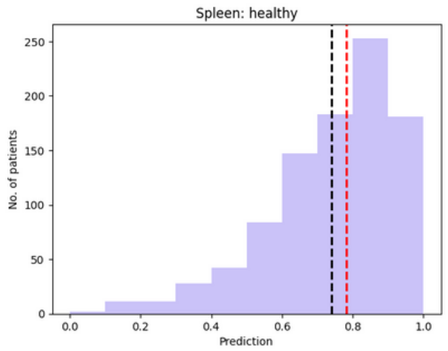

Kidney: high grade injury
No. of patients
Prediction

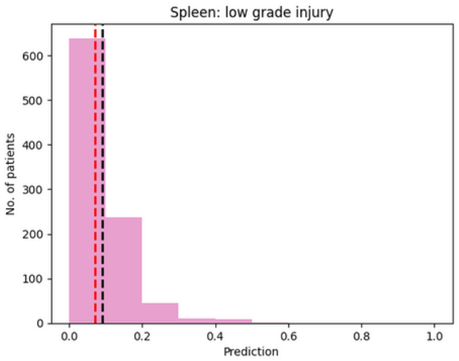

Liver: healthy
No. of patients
Prediction

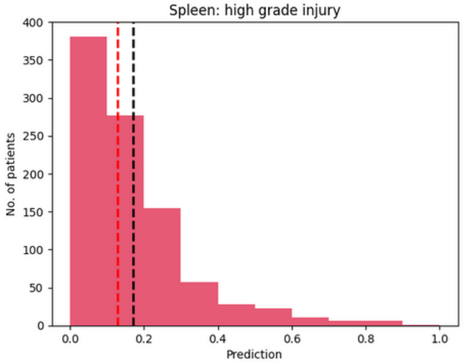

Liver: low grade injury
No. of patients
Prediction


Liver: high grade injury
No. of patients
Prediction

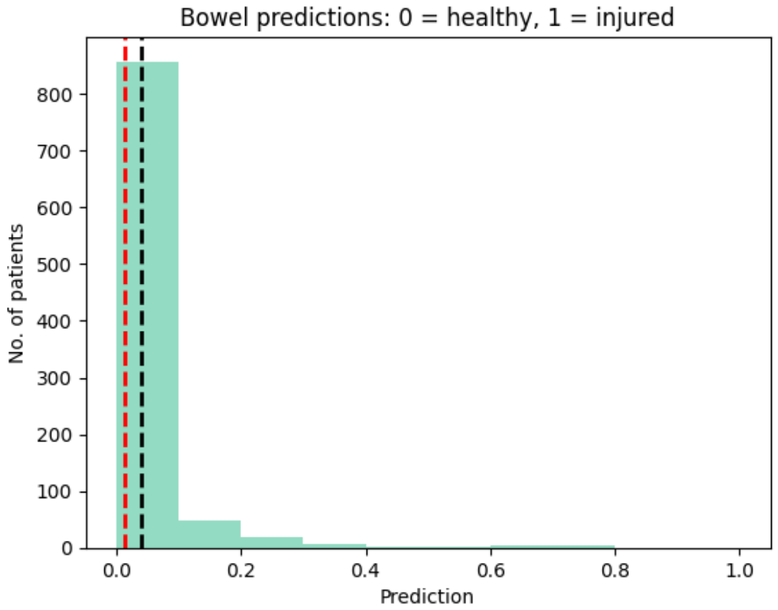


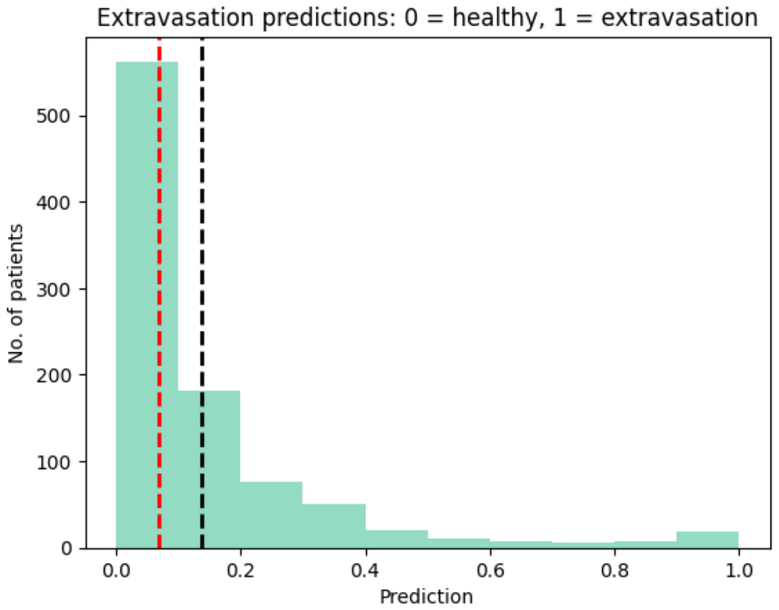

Spleen: healthy
No. of patients
Prediction

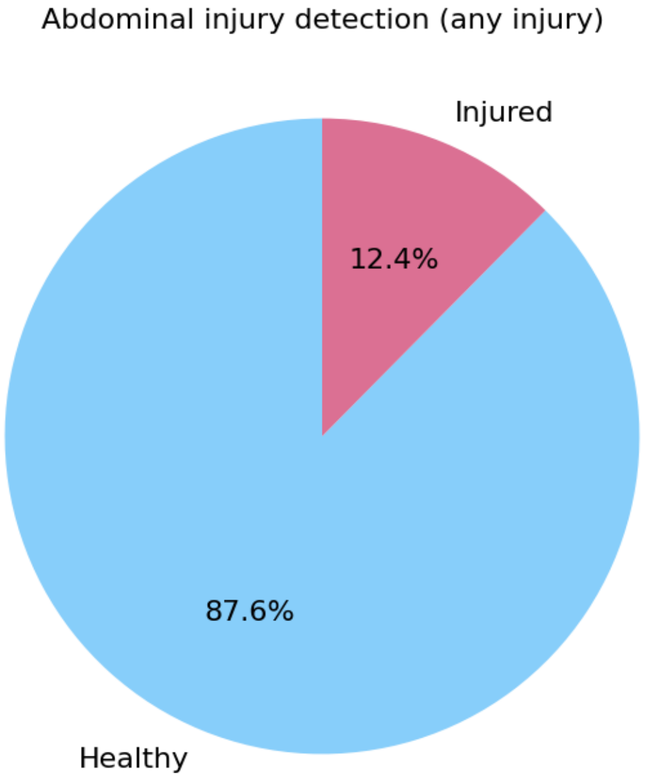

Spleen: low grade injury
No. of patients
Prediction


Spleen: high grade injury
No. of patients
Prediction

REZULTATI

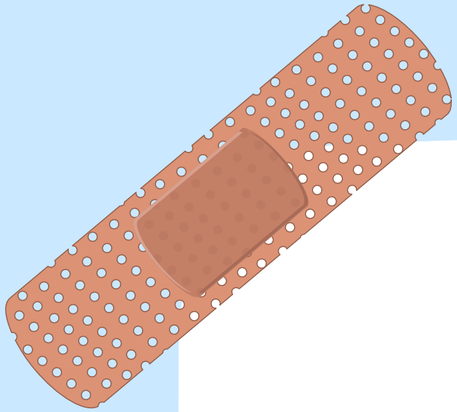

Bowel predictions: 0 = healthy, 1 = injured
No. of patients
Prediction
0
100
200
300
400
500
600
700
800
0.0
0.2
0.4
0.6
0.8
1.0

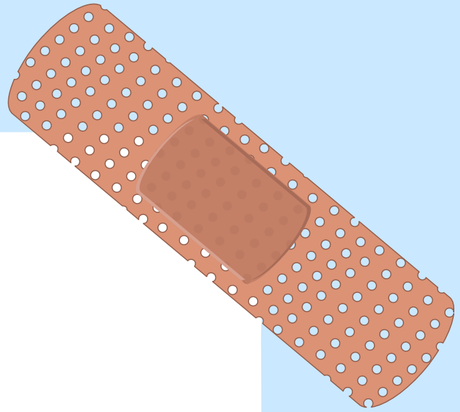

Extravasation predictions: 0 = healthy, 1 = extravasation
No. of patients
Prediction
0
100
200
300
400
500
0.0
0.2
0.4
0.6
0.8
1.0


Abdominal injury detection (any injury)
Injured
12.4%
87.6%
Healthy

ZAKLJUČAK

- neuronske mreže - moćan alat za analizu medicinskih slika
- zadovoljavajući rezultati s obzirom na prirodu ulaznih podataka i opseg projekta
- unaprjeđenje rezultata i eventualni budući rad - izrada mreže (“from scratch”) specifične za ovaj skup podataka umjesto korištenja treniranih modela





HVALA!

Avoid injury