



ZADÁNÍ BAKALÁŘSKÉ PRÁCE

Název: Detekce objektů v ptáčích hnízdech pomocí neuronových sítí
Student: Jan Havlík
Vedoucí: Ing. Josef Pavlíček, Ph.D.
Studijní program: Informatika
Studijní obor: Softwarové inženýrství
Katedra: Katedra softwarového inženýrství
Platnost zadání: Do konce letního semestru 2017/18

Pokyny pro vypracování

Navrhněte a implementujte knihovnu umožňující zpracovávat data z kamery umístěné v hnízdě (ptáčí budce) s cílem rozpoznat počet vajec v hnízdě. Pro rozpoznání použijte existující algoritmy umělé inteligence využívající data získaná ze serveru PtáciOnline.cz a další sw. nástroje projektu BirdObserver (athena.pef.czu.cz).

Postupujte v těchto krocích:

1. Proveďte detailní specifikaci požadavků.
2. Seznamte se s projektem BirdObserver a strukturou dat na serveru PtáciOnline.cz.
3. Proveďte analýzu a návrh knihovny.
4. Návrh implementujte, zdokumentujte a vhodným způsobem otestujte.
5. Knihovnu navrhněte a implementujte v jazyce Java tak, aby bylo možné ji formou závislostí (dependency) integrovat s ostatními nástroji projektu BirdObserver.

Seznam odborné literatury

Dodá vedoucí práce.

Ing. Michal Valenta, Ph.D.
vedoucí katedry

prof. Ing. Pavel Tvrdík, CSc.
děkan

V Praze dne 12. ledna 2017

ČESKÉ VYSOKÉ UČENÍ TECHNICKÉ V PRAZE
FAKULTA INFORMAČNÍCH TECHNOLOGIÍ
KATEDRA SOFTWAREVÉHO INŽENÝRSTVÍ



Bakalářská práce

Detekce objektů v ptačích hnízdech pomocí neuronových sítí

Jan Havlůj

Vedoucí práce: Ing. Josef Pavlíček, Ph.D.

29. prosince 2017

Poděkování

Chtěl bych poděkovat paní Ing. Petře Pavlíčkové Ph.D. za vstřícný přístup, odborné rady a pomoc při zpracovávání této práce. Mé díky patří také rodičům, kteří mi byli po celou dobu studia oporou. Velký dík patří také mým spolužákům, s kterými jsme se během studia vzájemně podporovali a kteří mě nikdy neváhali podpořit ve chvílích slabosti.

Prohlášení

Prohlašuji, že jsem předloženou práci vypracoval(a) samostatně a že jsem uvedl(a) veškeré použité informační zdroje v souladu s Metodickým pokynem o etické přípravě vysokoškolských závěrečných prací.

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V Praze dne 29. prosince 2017

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České vysoké učení technické v Praze

Fakulta informačních technologií

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Tato práce vznikla jako školní dílo na Českém vysokém učení technickém v Praze, Fakultě informačních technologií. Práce je chráněna právními předpisy a mezinárodními úmluvami o právu autorském a právech souvisejících s právem autorským. K jejímu užití, s výjimkou bezúplatných zákonných licencí, je nezbytný souhlas autora.

Odkaz na tuto práci

Havlůj, Jan. *Detekce objektů v ptačích hnízdech pomocí neuronových sítí*. Bakalářská práce. Praha: České vysoké učení technické v Praze, Fakulta informačních technologií, 2017.

Abstrakt

V několika větách shrňte obsah a přínos této práce v češtině. Po přečtení abstraktu by se čtenář měl mít čtenář dost informací pro rozhodnutí, zda chce Vaši práci číst.

Klíčová slova Nahradte seznamem klíčových slov v češtině oddělených čárkou.

Abstract

Sem doplňte ekvivalent abstraktu Vaší práce v angličtině.

Keywords Nahradte seznamem klíčových slov v angličtině oddělených čárkou.

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Úvod

Cíl práce

Cíl práce

Where does it come from?

Contrary to popular belief, Lorem Ipsum is not simply random text. It has roots in a piece of classical Latin literature from 45 BC, making it over 2000 years old. Richard McClintock, a Latin professor at Hampden-Sydney College in Virginia, looked up one of the more obscure Latin words, consectetur, from a Lorem Ipsum passage, and going through the cites of the word in classical literature, discovered the undoubtable source. Lorem Ipsum comes from sections 1.10.32 and 1.10.33 of "de Finibus Bonorum et Malorum" (The Extremes of Good and Evil) by Cicero, written in 45 BC. This book is a treatise on the theory of ethics, very popular during the Renaissance. The first line of Lorem Ipsum, "Lorem ipsum dolor sit amet..", comes from a line in section 1.10.32.

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Analýza a návrh

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Realizace

Závěr

Literatura

Seznam použitých zkratek

GUI Graphical user interface

XML Extensible markup language

HTML HyperText Markup Language

RAM Random-access memory

PDF Portable Document Format

NN Neural Network

CNN Convolutional Neural Network

RCNN Recursive Convolutional Neural Network

API Application Programming Interface

Dokumentace API knihovny

Příloha obsahuje dokumentaci API knihovny, která je výsledkem této práce. Dokumentace je vygenerována přímo ze zdrojového kódu nástroji javadoc a TexDoclet

B.1 Package org.cvut.havluja1.eggdetector

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B.1.1 Class EggDetector

B.1.1.1 Count the number of eggs in given images

The egg detector is a library that helps you count the number of eggs in a given folder. Egg detector works by using TeonsorFlow Object Detection API in the background. To learn more, see <https://www.tensorflow.com>.

Example usage:

```
EggDetector eggDetector = new EggDetector();
SequenceClassifier sequenceClassifier = eggDetector.evaluate(new File("image_dir"));
System.out.println("final count: " + sequenceClassifier.getFinalCount());
System.out.println("individual scores: " + sequenceClassifier.getIndividualCounts());
eggDetector.closeSession();
```

B.1.1.2 Declaration

```
public class EggDetector
    extends java.lang.Object
```

B.1.1.3 Constructor summary

EggDetector()

Constructor loads the pre-trained frozen graph into memory.

B.1.1.4 Method summary

closeSession()

Closes the EggDetector session.

evaluate(File)

Runs egg detection on a given *dir*.

getMinimalConfidence()

Get the minimalConfidence setting for this instance.

isDebugMode()

Get this instance's debug mode setting.

setDebugMode(boolean)

Set this instance's debug mode setting.

setMinimalConfidence(float)

Set the minimalConfidence setting for this instance.

toString()

B.1.1.5 Constructors

- *EggDetector*

```
public EggDetector()
```

- **Description**

Constructor loads the pre-trained frozen graph into memory.

It also checks whether TensorFlow is supported on your platform.

B.1.1.6 Methods

- *closeSession*

```
public void closeSession() throws java.lang.IllegalStateException
```

- **Description**

Closes the EggDetector session. This instance of EggDetector will not be usable again.

- **Throws**
 - * `java.lang.IllegalStateException` – if the session has been closed already by calling `closeSession()`

- *evaluate*

```
public SequenceClassifier evaluate(java.io.File dir) throws
    java.lang.IllegalArgumentException, java.lang.IllegalStateException
```

- **Description**

Runs egg detection on a given *dir*.
- **Parameters**
 - * *dir* – a directory containing .jpg or .png files for object detection
- **Returns** –
- **Throws**
 - * `java.lang.IllegalArgumentException` – if *dir* is not a directory or contains no images
 - * `java.lang.IllegalStateException` – if the session has been closed already by calling `closeSession()`

- *getMinimalConfidence*

```
public float getMinimalConfidence()
```

- **Description**

Get the *minimalConfidence* setting for this instance.

Minimal Confidence score is used as a confidence boundary during the process of object detection. An object that has been detected with a confidence score lower than *minimalConfidence* is ignored. An object that has been detected with a confidence score higher or equal than *minimalConfidence* is added to the final result list.
- **Returns** – This instance's *minimalConfidence* setting.

- *isDebugMode*

```
public boolean isDebugMode()
```

- **Description**

Get this instance's debug mode setting.

If debug mode is enabled (set to true), the library will open a `JFrame` for each processed image with detections graphically highlighted.
- **Returns** – debug mode setting for this instance

- *setDebugMode*

```
public void setDebugMode(boolean debugMode) throws  
    java.lang.IllegalStateException
```

- **Description**

Set this instance's debug mode setting.

If debug mode is enabled (set to true), the library will open a `JFrame` for each processed image with detections graphically highlighted.

- **Parameters**

- * `debugMode` – turn the debug mode on or off

- **Throws**

- * `java.lang.IllegalStateException` – if the session has been closed already by calling `closeSession()`

- *setMinimalConfidence*

```
public void setMinimalConfidence(float minimalConfidence) throws  
    java.lang.IllegalStateException
```

- **Description**

Set the *minimalConfidence* setting for this instance.

Minimal Confidence score is used as a confidence boundary during the process of object detection. An object that has been detected with a confidence score lower than *minimalConfidence* is ignored. An object that has been detected with a confidence score higher or equal than *minimalConfidence* is added to the final result list.

- **Parameters**

- * `minimalConfidence` – *minimalConfidence* for this instance

- **Throws**

- * `java.lang.IllegalStateException` – if the session has been closed already by calling `closeSession()`

- *toString*

```
public java.lang.String toString()
```

B.1.2 Class SequenceClassifier

B.1.2.1 A class containing object detection results for a given directory

SequenceClassifier is a data class containing the results of object detection for a given directory. When constructed, object detection is performed on all images and results are stored in memory.

Example usage:

```
EggDetector eggDetector = new EggDetector();
SequenceClassifier sequenceClassifier = eggDetector.evaluate(new File("image_dir"));
System.out.println("final count: " + sequenceClassifier.getFinalCount());
System.out.println("individual scores: " + sequenceClassifier.getIndividualCounts());
eggDetector.closeSession();
```

B.1.2.2 Declaration

```
public class SequenceClassifier
    extends java.lang.Object
```

B.1.2.3 Method summary

getFinalCount()

Get the final score for the entire directory.

getIndividualCounts()

Gets the individual egg count for every image provided.

B.1.2.4 Methods

- *getFinalCount*

```
public java.lang.Integer getFinalCount()
```

- **Description**

Get the final score for the entire directory.

The final score is calculated as follows:

- * individual scores of images are sorted and counted
- * the highest egg count is returned as a result if we detected this egg count in at least two different images
- * if no two images contain the same egg count, the highest detected egg count is returned
- * if no eggs are detected in any of the images, 0 is returned

- **Returns** – final egg count for this instance

- *getIndividualCounts*

```
public java.util.Map getIndividualCounts()
```

- **Description**

Gets the individual egg count for every image provided.

- **Returns** – A map of individual scores. The key is the filename. The value is the egg count.

Použité programy

TexStudio psaní bakalářské práce v \LaTeX a překlad do PDF

Notepad++ úprava textových souborů

gedit úprava textových souborů

IntelliJ IDEA Ultimate psaní implementace v jazyce Java

GIT verzování kódu

JDK8 kompilace, ladění a testování Java knihovny

Python 3 zpracování dat, trénování neuronových sítí

Tensorflow softwarová knihovna pro strojové učení

LabelImg označování trénovacích dat

javadoc generování dokumentace do HTML

TexDoclet generování dokumentace do \LaTeX

wget hromadné stahování dat

bash pomocné skripty pro zautomatizování práce

Obsah přiloženého CD

readme.txt	stručný popis obsahu CD
bin	adresář se spustitelnou formou implementace
doc	adresář s dokumentací implementace
src	
impl	zdrojové kódy implementace
eggdetector	zdrojové kódy implementace knihovny
nn_training	zdrojové kódy pro trénování neuronové sítě
tools	zdrojové kódy pomocných nástrojů k tvorbě bakalářské práce
thesis	zdrojová forma práce ve formátu \LaTeX
text	text práce
thesis.pdf	text práce ve formátu PDF