# Writer Identification Using Deep Neural Networks: Impact of Patch Size and Number of Patches

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### Outline

- **1** Motivation
- 2 Methods
- 3 Approach
- 4 Experiments
- **5** Results

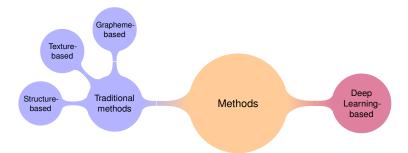
#### **Motivation**

Writer 1	Writer 2	Writer 3
'K' 'M' 'g'	'K' 'M' 'g'	Writer 3
k Mg	k m g	KMS
KMg	k m g	KMS
'F '9' '3'	J83.	'f' '9' '3'
J 9 3	9 3	7 9 3
193	f 9 3	197
'veilingen'	'veilingen'	'veilingen'
veilingen	veilingen	vei liger
veilingen	veilingen	veiliger

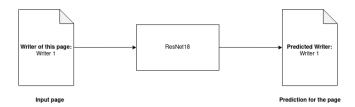
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[1]

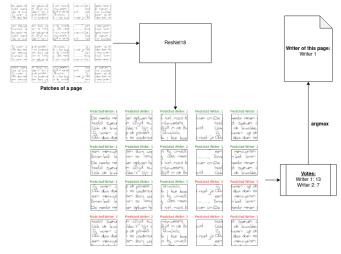
### Methods



# Model based on full-pages



# Model based on patches



Prediction for each patch



# Datasets Firemaker

Bob, David en soxy Nantippe sparen poolzegels van de larden Etimpe, Topan, Algeria, de USA, Holland, Hallet, Greekenland en Canada.

Bob, David en Sery Kantippe sparen postregels van de landen Egypte, Japan, Algerje, de USA, Holland, Stalië, Grietenland en Canada.

Ecb , Pand in vezy Xantigoi sparin postoepels van de landin Egypte , Tozaan , Apprye de USA , Holland , Halit , Griskerland in Canada

Dataset	Writers	Training '	Validation	Testing	Total pages
Firemaker	250	1 page		1 page	500
IAM	657	1 page/ ha	If page	1 page/ half page	1314
ICDAR17	720	3 pages	1 page	1 page	3600

# Datasets Firemaker

Bob, David en sony Mantippe goard, poolzeggels van de larden Etyppe, Japan, Algerija, ole USA, Holland, Hallel, Griekenland en Canada.

Bob, David en sexy Kantippe sparen postregels van de landen Egypte, Japan, Algerje, de USA, Holland, Stalië, Grietenland en Canada.

Ech , Navid en évez Xanligue sparen postoegels van de landen Egypte , Japan , Afgerje de USA Holland , Halse , Criskerland en Canada

#### IAM

Evaporation of sodium from the pool c in minimised by a close filing cyclindrical

Only the neights of the recovered lead chromate precipitates need be known because the concentration

This development coincided with the introduction of pressurized aircraft cabins and the demand for air-to-air

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#### **ICDAR 2017**







# Preprocessing

- Crop
- Text padding
- Normalize

# Text padding

proefer:	geb.dat:	90378	man	links rechts
	huisnr:	-	k' vrouw  Beschriiving cartoon.	rechts

De neede men oploven het niet, moon boven on shooted zweer alltijd avainteweeren. Och de kwalker's zijn alltijd in de bwat. Zij woen op de plonet kwalkels. Och daa den ze anderzeld : kee head noel je een mensweten stoch woo die in omen word word men ze onderzeld : noel lije een mensweten stoch woo hij anvall.

De neeste mensen oplouen het niet, mook bouen on sDe meeste mensen ( hoofd zwever allight acimbervezers hoofd zweven d Odu de kwaldars zijn allijd in de bucet. Ooli de kwalilia Zij wonen op de ploneet trucksla Zii wonen op de Obli door doen ze onderzoeli : hoe hord noeli je Obli door doen ze een menswezen sloon voor hij onvall: een menswezen Binnen hod: homen are liency vaor meer Binner book homen De neesle mensen oploven het niet, mook boven on sDe meesle mensen ( hoofd zweven altijd acimbewezens hoofd zweven d Odu de kwaldars zijn altijd in de bucet. Ool de kwalda Zij wonen op de ploneel- tewchola Zii, wonen op de Obli door doen ze onderzoeli : hoe hord noeli je Obli door doen ze een mensuezen skon voor hij omvall: een menswezen Binnen hoalt homen are lience, vaour meer Binner hook homen De meeste menien aelauen het niet maar bauen onsDe meeste menien ( hoofd zweven allight acimbewezens hoofd zweven d Odu de kwaldla's zijn allijd in de bucet. Ook de kwalda Zij wonen op de planeel tewaliala Zij wonen op de Obli door doen ze onderzoeli : hoe hord noeli je Obli door doen ze een mensuezen skon voor hij omvall: een menswezen Binnen hoalt homen se tenca voor meer ... Binner book homen

# Experiments:

# **Patches**

Patch size IAM		Firemaker	ICDAR17
100	84.8	78.0	22.6
256	95.7	98.0	63.8
500	96.8	98.0	78.3
600	96.8	98.4	81.0
800	94.6	98.4	83.6
1000	95.0	99.2	-
1200	95.4	-	82.5

Table: Accuracy (in %) for increasing patch sizes. The number of patches was 300 for IAM and Firemaker and 64 for ICDAR17

# Experiments: Full-pages

Dataset	Batch size	Learning rate	Top1 (%)
IAM	9	0.002	91.34
Firemaker	6	0.003	98.32

# Experiments: Historical manuscripts

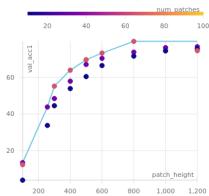
Dataset	Batch size	Learning rate	Top1 (%)
ICDAR17	9	0.002	75.42

Table: Best model with full-pages

Dataset	Num patches	Patch size	Top1 (%)	Patch accuracy (%)
ICDAR17	64	800	83.75	80.1

Table: Best model with patches

#### Evolution of ICDAR17 patch accuracy over patch sizes



### Results on the IAM dataset

Year	Feature	Classifier	Ref.	Writers	Top1 (%)	Top5 (%)	Top10 (%)
2020	CNN with word fra	CNN with word fragments (FragNet-64)		657	96.3	_	_
2019	SIFT + RootSIFT	GMM	[7]	650	97.85	_	_
2018	CNN with tuples of	of images of size 64x64	[16]	650	93.14	_	_
2016	Multi-stream CNN	(DeepWriter)	[17]	657	97.3	_	_
2016	$p(ls,l\theta), p(lBOS)$		[8]	657	86.9	91.6	94.7
2016	Chain code	KDA	[5]	650	82.7	_	92.2
2015	Graphemes	SR-KDA	[9]	657	92	93	97
2014	MSDH + TDH	KNN	[2]	657	97.1	98.8	99.2
2014	SDS + SOH	Euclidean	[3]	657	98.5	99.1	99.5
2013	Texture LPQ	SVM	[6]	650	96.7	_	_
2013	Connected	KNN, x2	[10]	650	94.8	_	_
2012	Quill-Hinge	NN	[4]	657	97	_	98
2012	SIFT	x2	[11]	650	93.1	_	_
2011	KAS	SVM	[12]	650	92.1	94.5	95.8
2010	Codebook	KNN	[14]	650	91		97
2010	and contour	KININ	[14]	630	91	_	97
2007	Contour PDFs	PDFs	[1]	650	89	_	97
2007	and ink trace	1013	ניו	030	03	_	31
2020	CNN with patches	of size 600	Ours	657	96.3	_	_



## Results on the Firemaker dataset

Year	Feature	Classifier	Ref.	Writers	Top1 (%)	Top5 (%)	Top10 (%)
2020	CNN with word fra	gments (FragNet-64)	[15]	250	97.6	_	_
2019	SIFT + RootSIFT	GMM	[7]	250	97.98	_	_
2019	CNN with tuples of	f images of size 64x64	[16]	250	93.56	_	_
2014	SDS + SOH	Euclidean	[3]	250	92.4	96.2	98.8
2013	Connected	KNN, x2	[10]	250	95.2	_	99.2
2012	Quill-Hinge	NN	[4]	251	86	_	97
2007	Contour PDFs and ink trace	PDFs	[1]	250	83	-	95
2020	CNN with patches	of size 1500	Ours	250	99.2	-	_

### Conclusions

- Proposed a new preprosessing method called *Text padding*
- Demonstrated the promising performance of using bigger patch sizes
- Provided an open-source <sup>1</sup> deep learning based writer identification system that obtained competitive accuracy

<sup>1</sup>github.com/akpun/writer-identification (5) (2)

Thanks for watching!
Contact: akpun@inf.upv.es

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