Literature research:

❏ **Title of paper:** Fully Convolutional Network Ensembles for White Matter Hyperintensities Segmentation in MR Images
❏ Ranked 1st in WMH Segmentation Challenge at MICCAI 2017 , https://wmh.isi.uu.nl/details/#terms suggesting to be State of the art technique

Dataset:

❏ Preprocessed training data are available in the format of .npy files
❏ To obtain the actual data https://wmh.isi.uu.nl/details/#terms need to sign a confidentiality agreement and send to wmh@isi.uu.nl

Technique used to detect WMH:

❏ Used deep fully convolutional network and ensemble models
❏ Based on the papers:
  ❏ Fully Convolutional Networks for Semantic Segmentation (by Long et al)
  ❏ U-Net: Convolutional networks for biomedical image segmentation (by Ronneberger et al)

Why this technique is used?

Result of WMH Segmentation Challenge:

❏ Predominantly most of the teams have used Deep Learning
❏ CNN or U-Net performs better when compared to other methods

#	Team	Pre[1]	Method	Post[2]	Data	DL[3]	Aug[4]	Loss function	Neural network features[5]							
									Dim	Dil	BN	Drop	MS	LR	HN	Ens
1	sysu_media	I,R	U-Net	SL	T,F	✓	H,R,S	DSC	2D							✓
2	cian	F,I	MDGRU		T,F	✓	D,R,S	multinom. log.	2D†			✓				
3	nlp_logix	I,S	CNN		T,F	✓		cross-entropy	2D			✓	✓	✓	✓	✓
4	nic-vicorob		CNN	SM	T,F	✓	M,R	cross-entropy	3D		✓	✓			✓	
5	k2	I,R,S	U-Net		T,F	✓	M	DSC	2D			✓		✓		✓
6	misp	I,R	CNN		T,F	✓		mean sq. error	3D		✓	✓			✓	
7	lrde	F,I	VGG-16		T,F	✓	R,S	multinom. log.	2D					✓		
8	nih_cidi	S	U-Net	G	T,F	✓	M,R	cross-entropy	2D		✓			✓		
9	ipmi-bern	I,S	U-Net		T,F	✓	M,R	cross-entropy	2D		✓		✓	✓		
10	scan	S	DenseNet		T,F	✓		cross-entropy	2D	✓						
11	achilles	I,R	HighResNet		F	✓	R,S	DSC	3D	✓	✓		✓			
12	skkumedneuro	I,S	RF		T,F											
13	tignet	B,I,T	HighResNet		T,F*	✓		DSC	3D	✓	✓			✓		
14	tig	B,S,T	GMM	FP	T,F											
15	knight	B,I,S,T	VLR	SM	F*		M,T,Y	DSC								
16	upc_dlmi	I	U-Net		T,F	✓	M	DSC	3D		✓		✓	✓		
17	nist	B,I,T	RF		T,F											
18	neuro.ml		DeepMedic		T,F	✓		cross-entropy	3D				✓	✓		
19	text_class	I,R	RF	SM	T,F											
20	hadi		RF		T,F											

- ❏ FCN based on U-Net (with a network architecture of 19 layers - Conv 3x3, ReLU and MaxPooling) can classify all the pixels simultaneously and tracks objects in an image.
- ❏ Voting of the object classification (pixel labels) is based on the ensemble models.

Advantages:

- ❏ Ensemble model reduces overfitting problems
- ❏ Usage of 2D architecture over 3D, as WMH are small lesions and does not possess high spatial or contextual information.

https://ieeexplore.ieee.org/document/8669968