



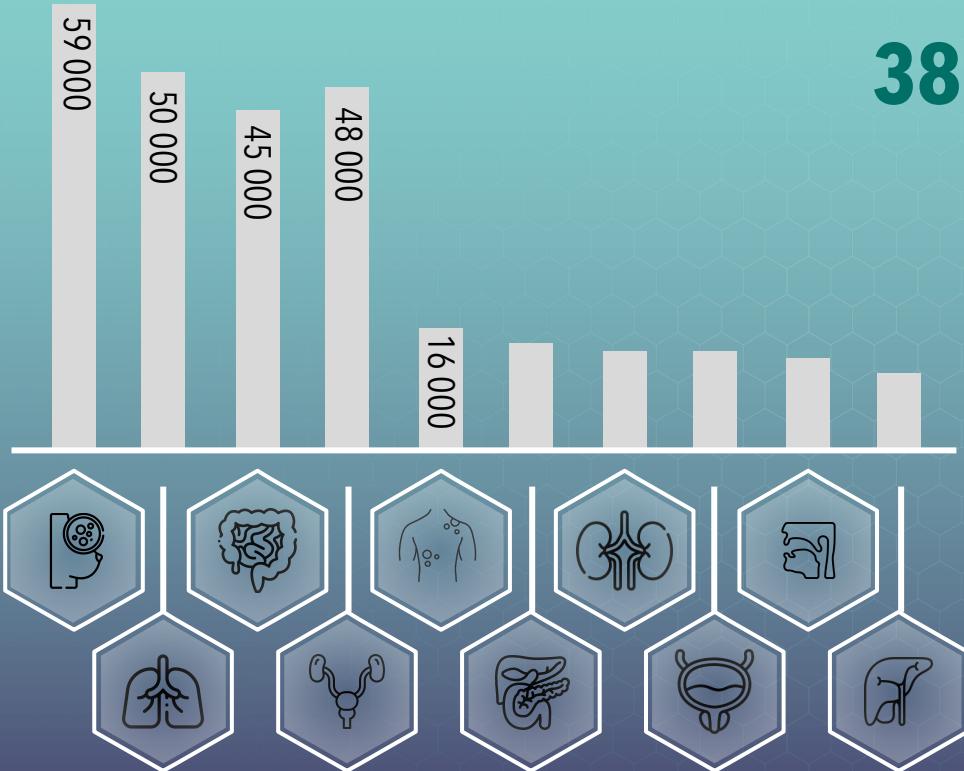
F. Devred / S. Ayache

P. Tsvetkov / E. Tabouret / R. Eyraud

Classification automatique de profils de dénaturation plasmatique pour la détection de cancers

Colloque en Sciences Numériques et IA pour la Santé à Aix-Marseille Université
Faculté des Sciences Médicales et Paramédicales
25-26 Novembre 2021

New cancer cases per year (France)



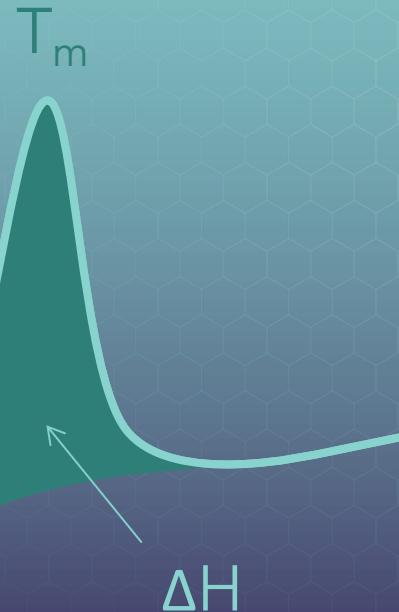
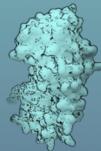
385 000 new cases

Diagnosis and monitoring tests:
often invasive
tissue specific
not always sensitive

Differential Scanning Calorimetry

(T_m , ΔH)

Unique parameters
for each protein

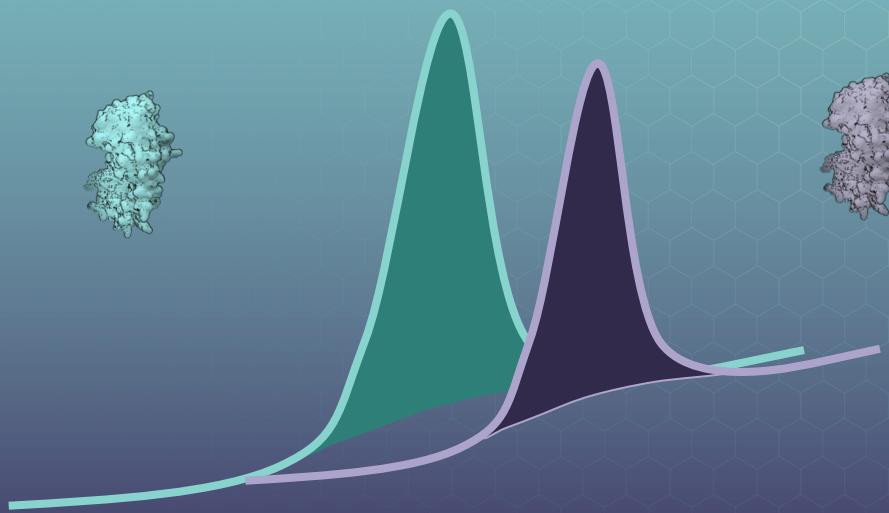
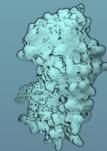


Differential Scanning Calorimetry

(T_m , ΔH)

Non covalent interaction,
mutation, PTM,
concentration...

(T_m , ΔH)

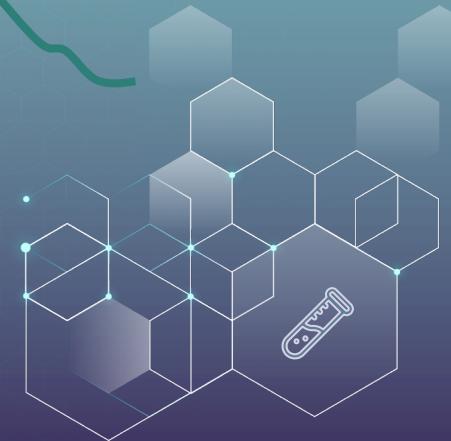
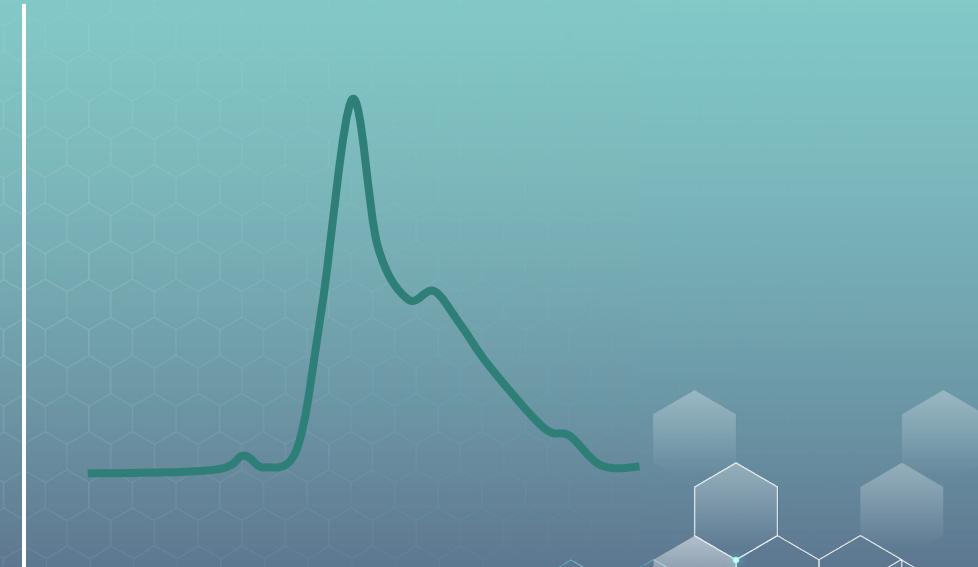




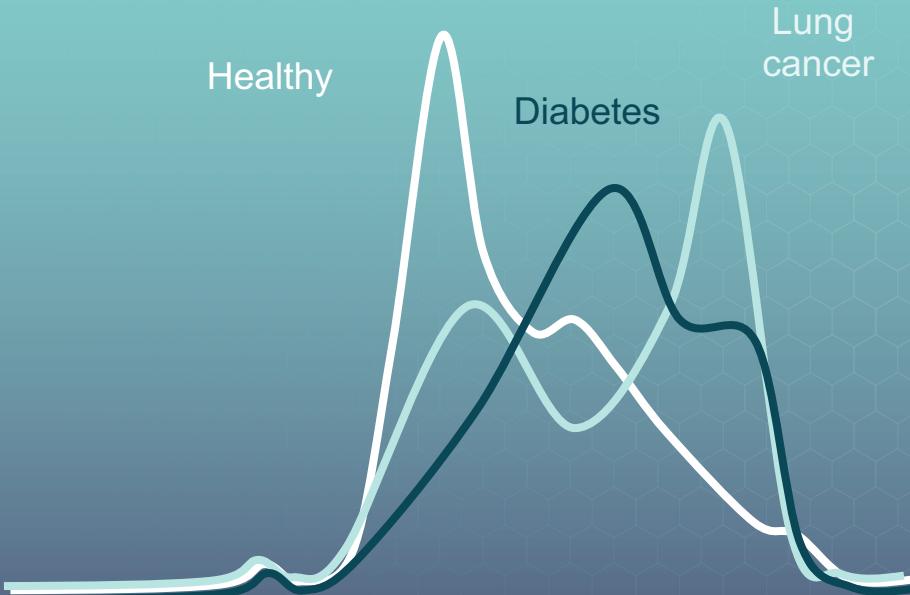
Differential Scanning Calorimetry

Human Plasma Denaturation

Denaturation profile of plasma is the sum of profiles of most abundant proteins



DSC signatures of diseases



(Garbett et al. 2014)

- Lyme disease
- Diabetes
- Coronary artery disease
- Lupus erythematosus
- Rheumatoid arthritis
- ALS
- Cancers
 - Endometrial
 - Cervical
 - Ovarian
 - Lung
 - Melanoma
 - Breast
 - Colorectal
 - Lymphoma



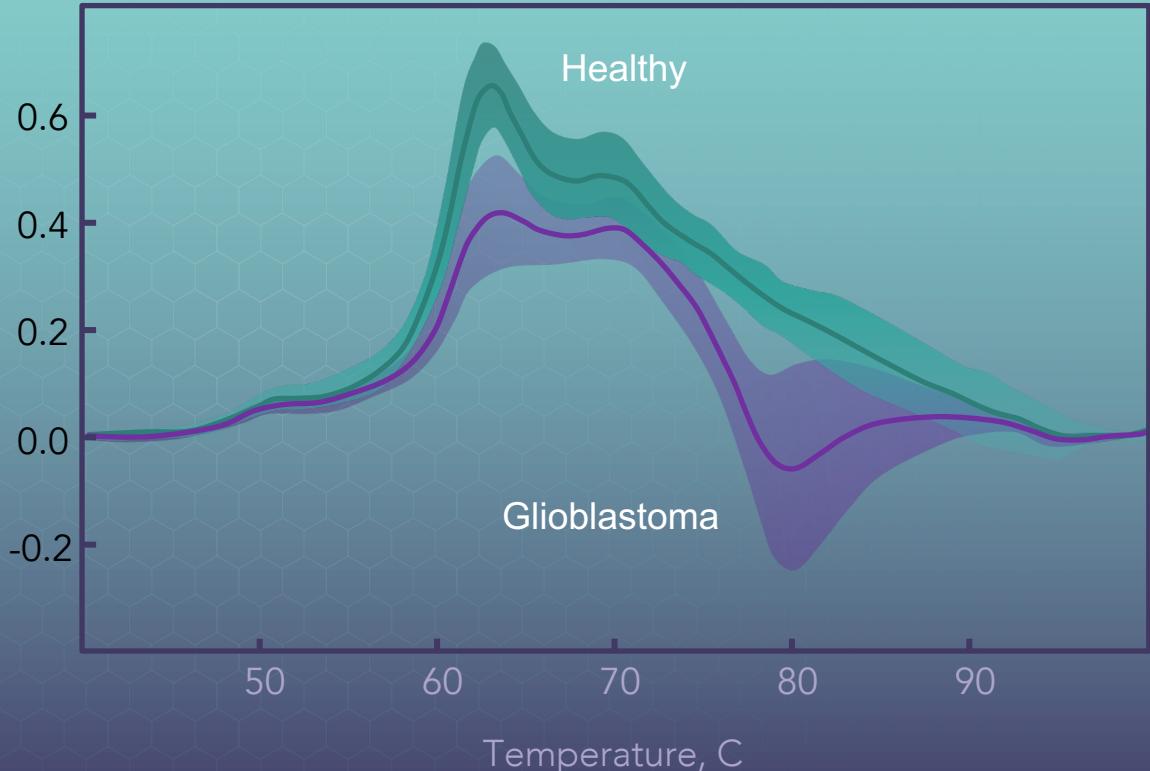
DSC signatures of Glioma



Patients
17



Healthy controls
10



(Tsvetkov et al. Oncotarget 2018)

nanoDSF signatures of Glioma

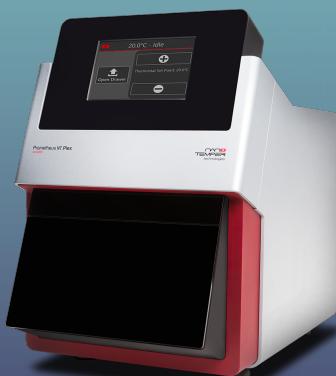


Patients
78

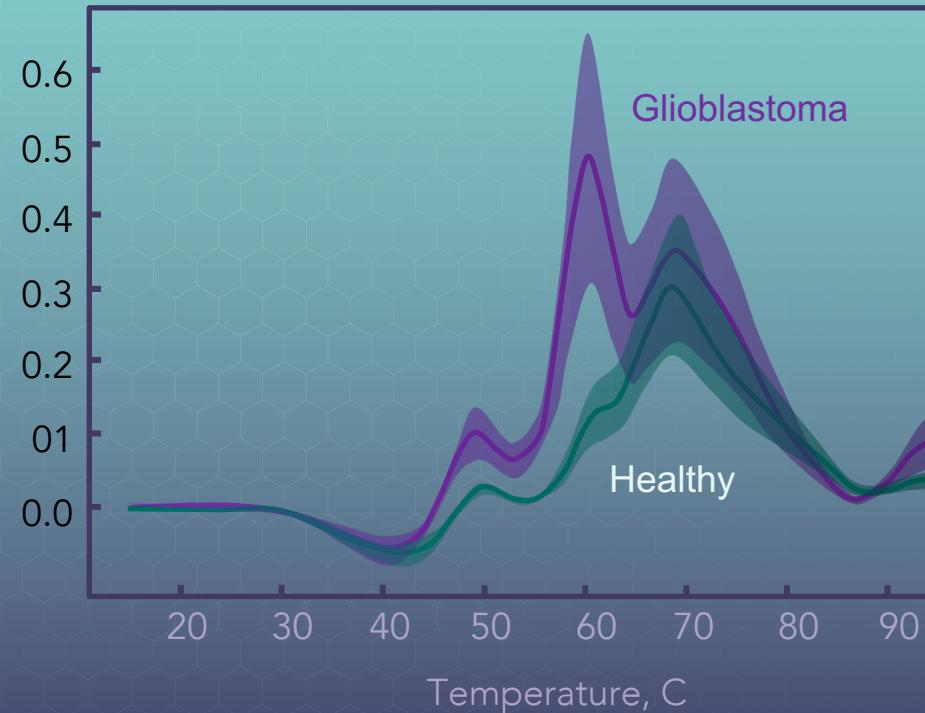


Healthy controls
44

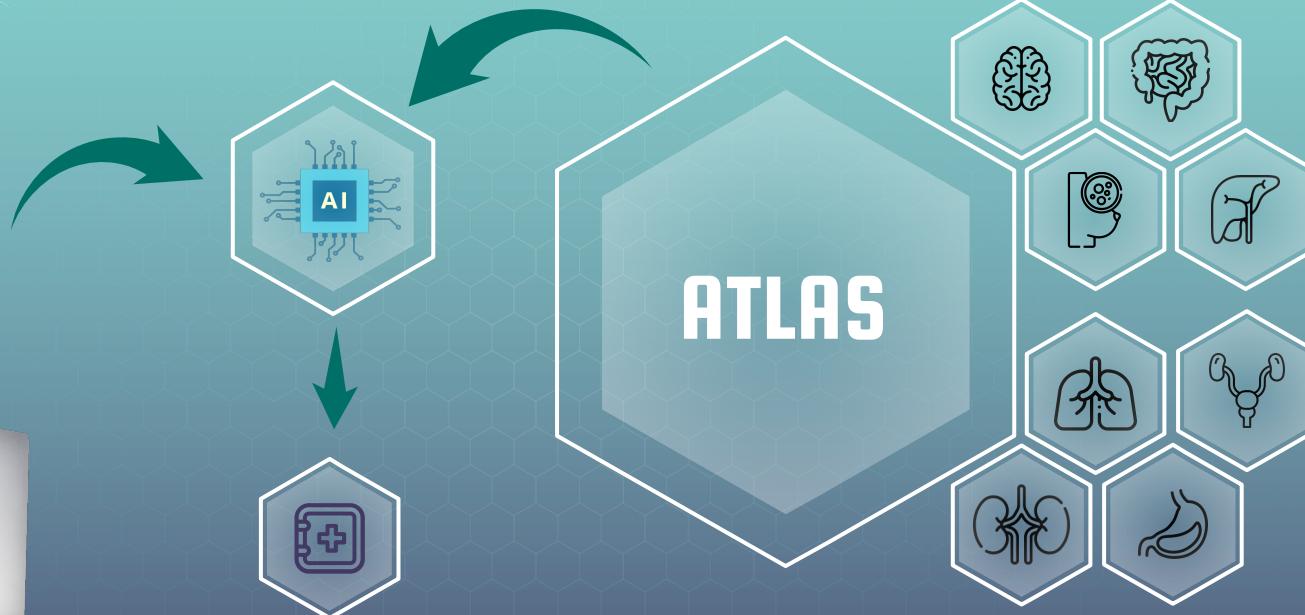
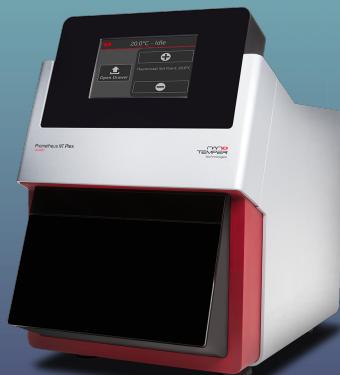




nanoDSF signatures of Glioma

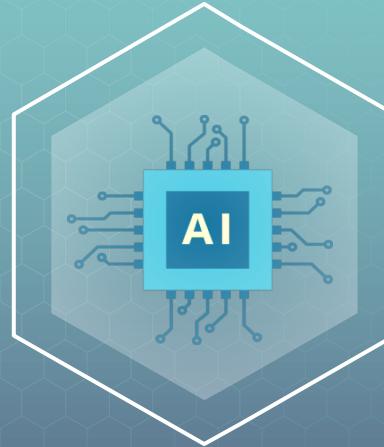
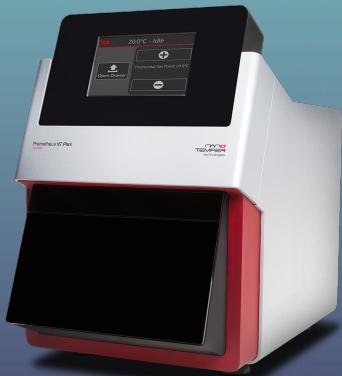


nanoDSF diagnostics of cancers





nanoDSF signatures of Glioma



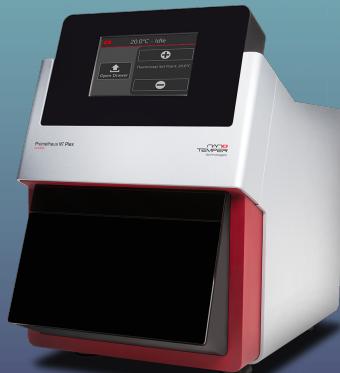


nanoDSF signatures of Glioma

Data preprocessing

Machine Learning

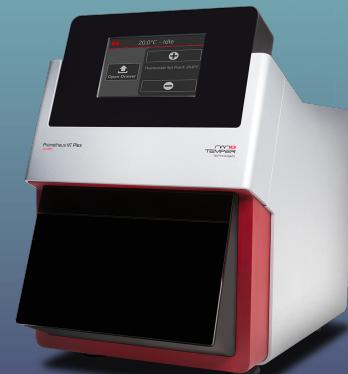
Evaluation





nanoDSF signatures of Glioma

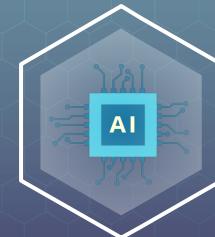
Data preprocessing



- Logistic Regression (LR)
- Support Vector Machine (SVM)
- Deep Neural Networks (NN)
- Random Forest (RF)
- AdaBoost

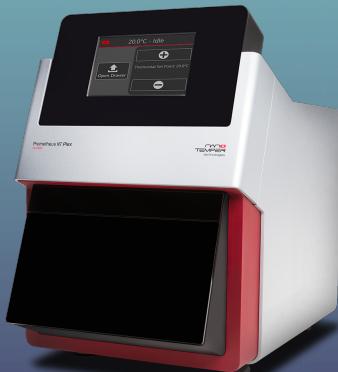
Machine Learning

Evaluation



nanoDSF signatures of Glioma

Data preprocessing

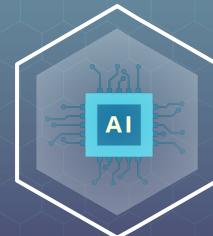


Machine Learning

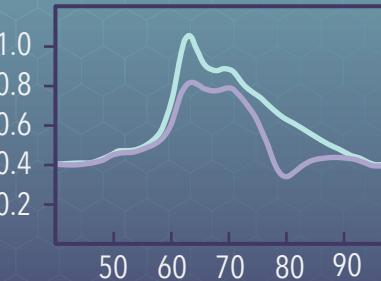
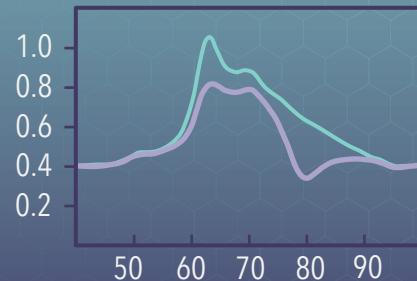
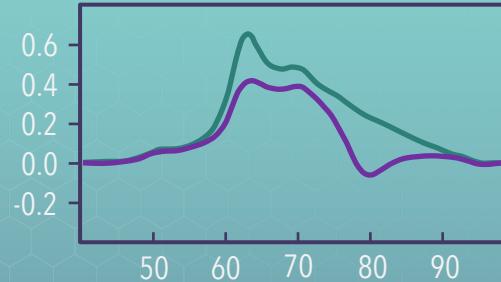
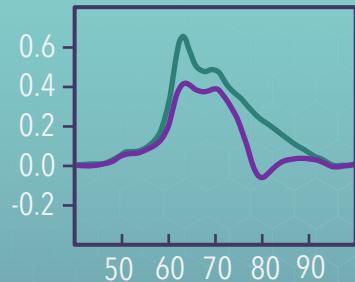
- Logistic Regression (LR)
 - Support Vector Machine (SVM)
 - Deep Neural Networks (NN)
 - Random Forest (RF)
 - AdaBoost

Evaluation

- Leave-one-out protocol
 - Experiments with python sklearn



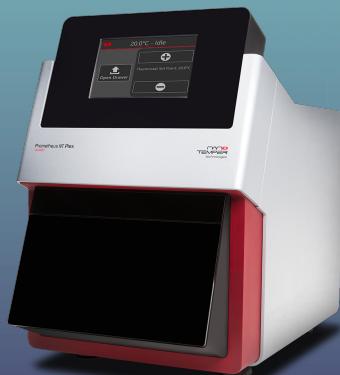
Preprocessing



- Interpolation
(Univariate spline)
- Scaling

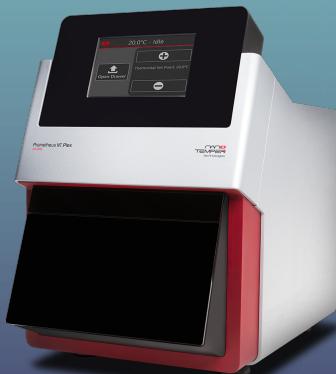


nanoDSF signatures of Glioma



LR

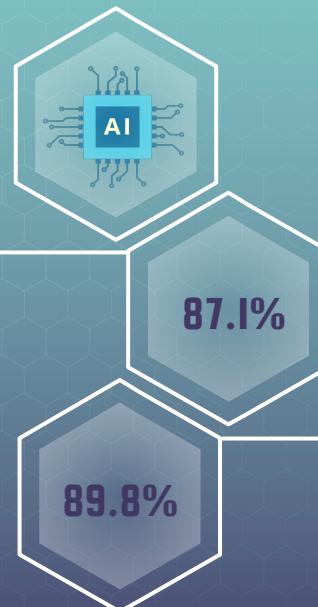
False positives 4
False negative 11



nanoDSF signatures of Glioma

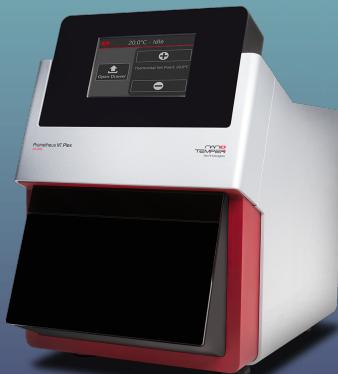
SVM

False positives 13
False negative 6

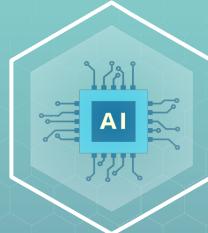


LR

False positives 4
False negative 11



nanoDSF signatures of Glioma



SVM

False positives 13
False negative 6

92.5%



LR

False positives 4
False negative 11

87.1%

89.8%



AdaBoost

False positives 6
False negative 5

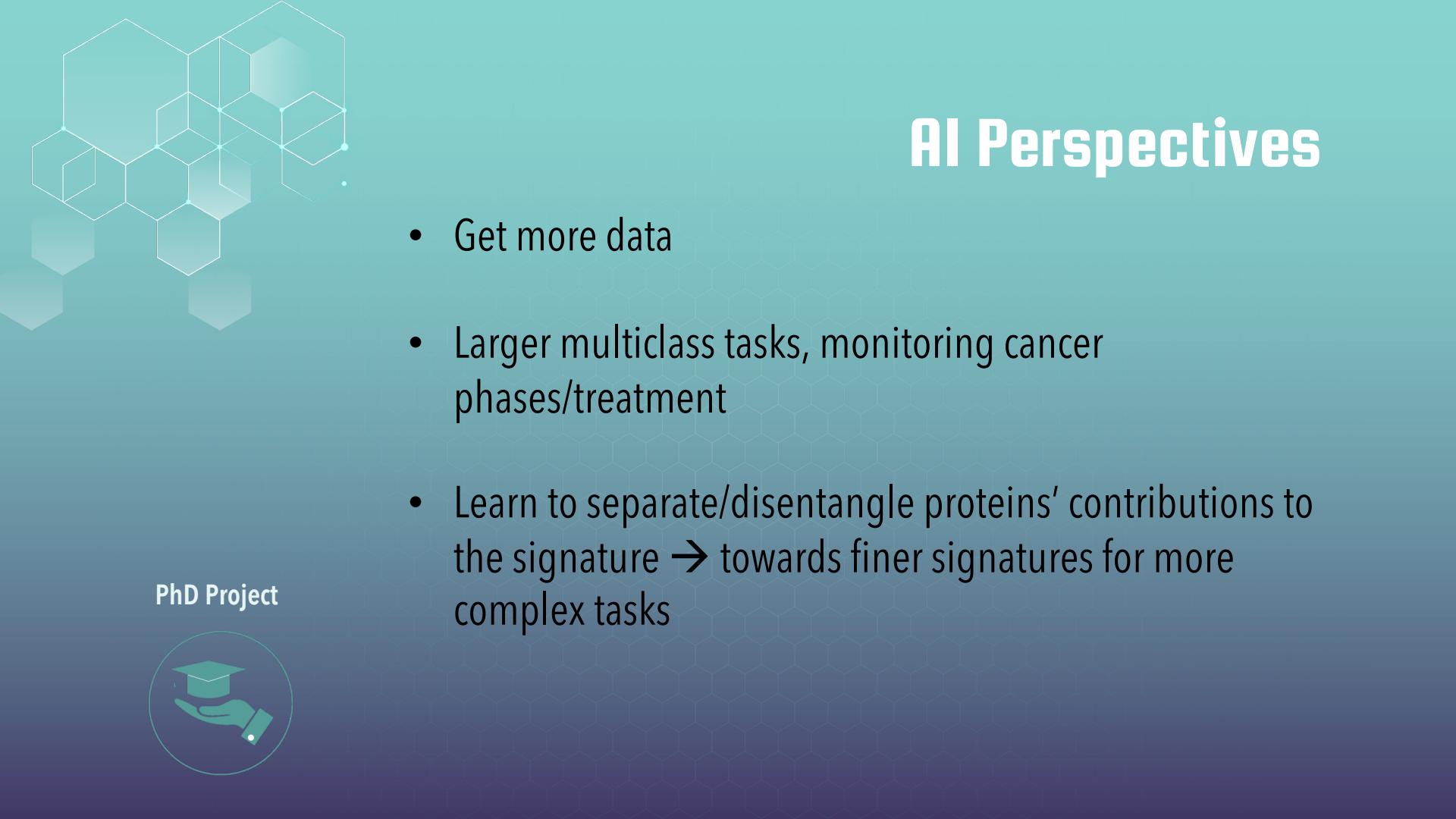
(Tsvetkov et al. Cancers 2021)

Evaluation

Algorithm	LR	SVM	NN	RF	AdaBoost
Accuracy	89.80	87.07	92.52	89.12	92.52
False positives	4	13	5	8	6
False negatives	11	6	6	8	5

*

Accuracy scores estimated by leave-one-out protocol



AI Perspectives

- Get more data
- Larger multiclass tasks, monitoring cancer phases/treatment
- Learn to separate/disentangle proteins' contributions to the signature → towards finer signatures for more complex tasks

PhD Project





Medical Perspectives



Neuro Oncology
Thoracic Oncology
Urologic Oncology
Oncology-Dermatology
Digestive oncology
Breast Oncology

PRT-K

Hôpitaux
Universitaires
de Marseille

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hm



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