



princess
máxima
center
pediatric oncology

Supersnel hersentumoren herkennen met AI

Jeroen de Ridder

Princess Máxima Center

Center for Molecular Medicine, UMC Utrecht

Oncode Principal Investigator

Co-founder Cyclomics BV



UMC Utrecht



**Oncode
Institute**

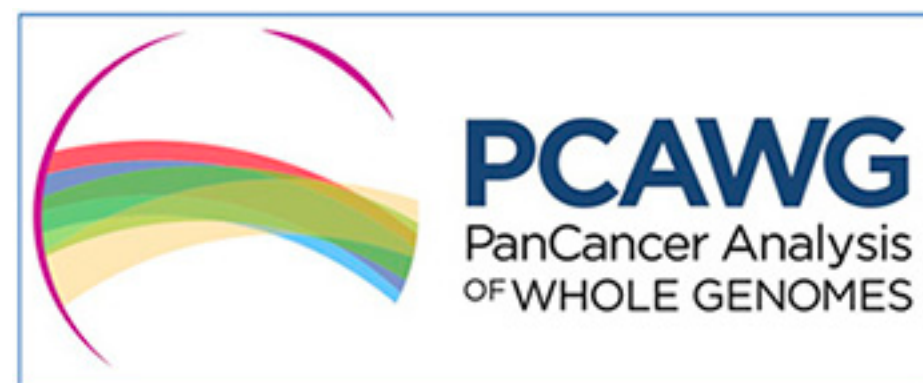
Outsmarting cancer Impacting lives

Hoe werkt dit?



Hoe kunnen we het gebruiken?

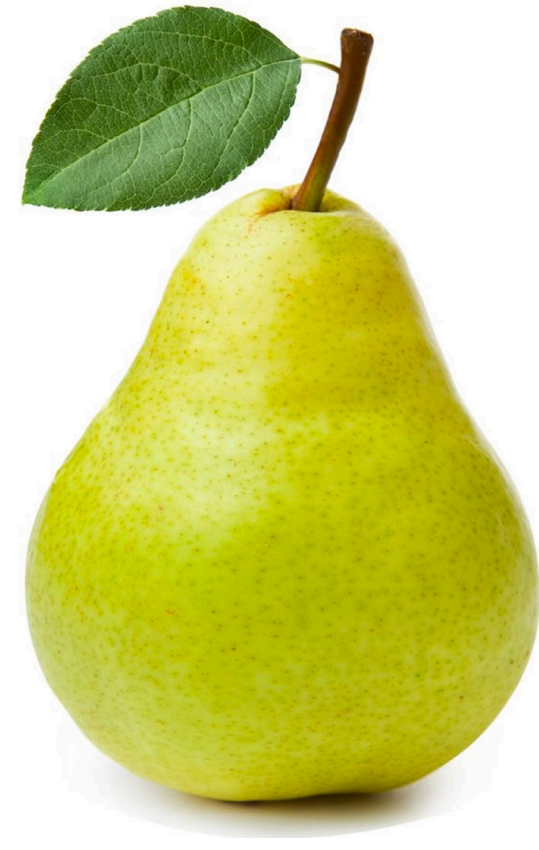
The 'dataficatie' van de levenswetenschappen



Hoe kunnen we van data leren?



OF



?

Hoe kunnen we van data leren?



Metingen



- Groote
- Vorm
- Kleur
- Textuur

Hoe kunnen we van data leren?



Hoe kunnen we van data leren?

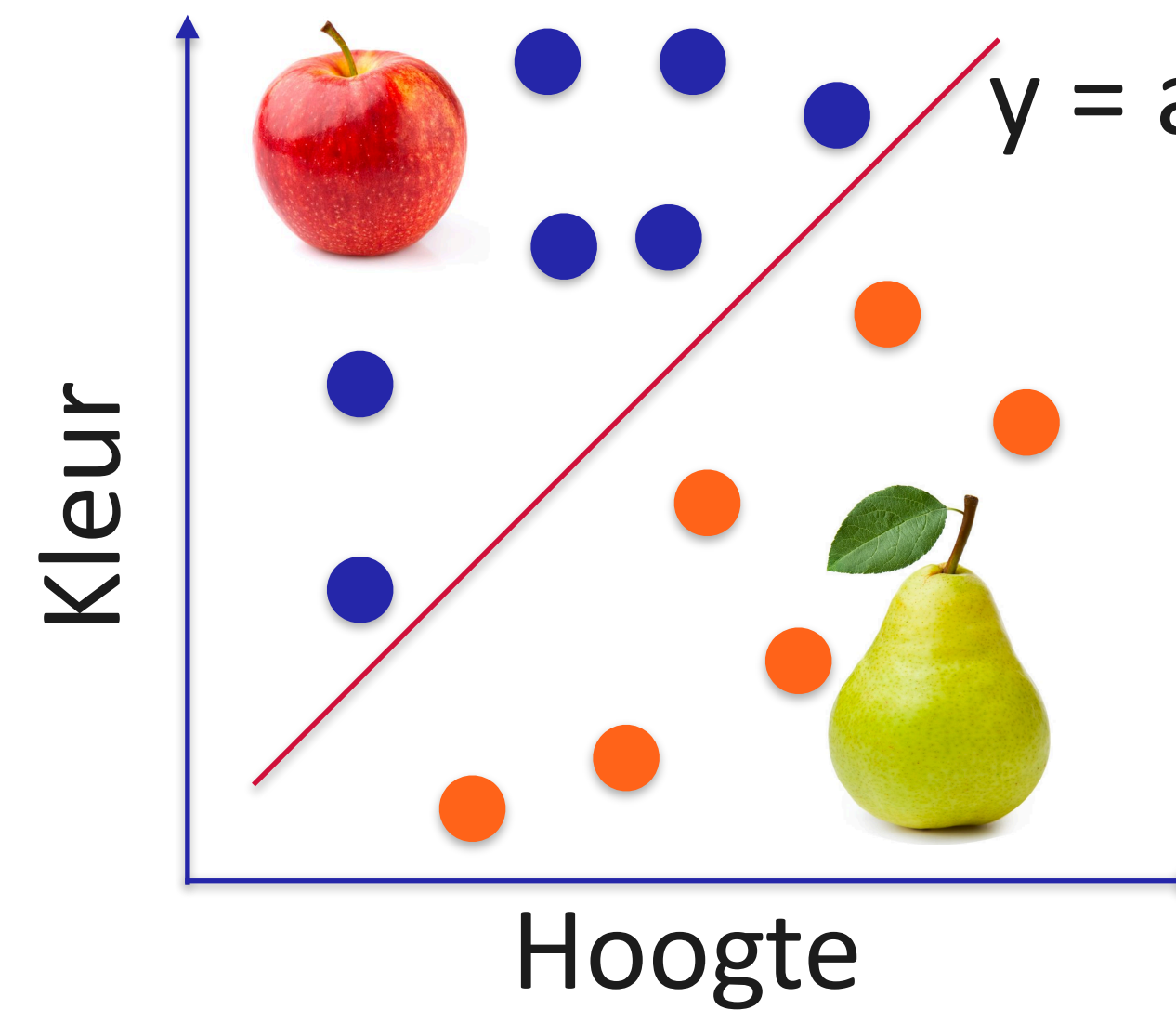


Hoe kunnen we van data leren?



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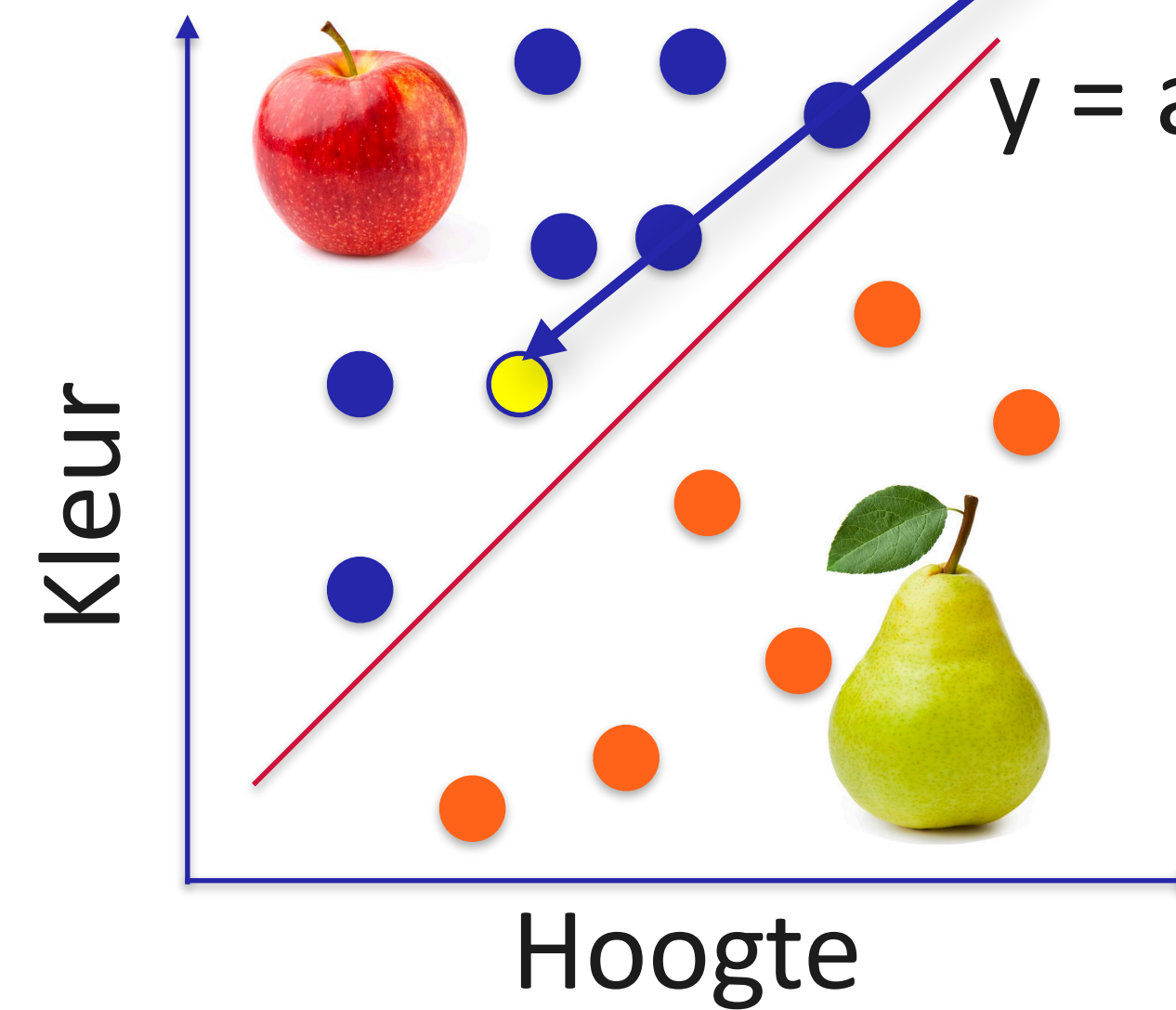


Hoe kunnen we van data leren?



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- Textuur



Klasse

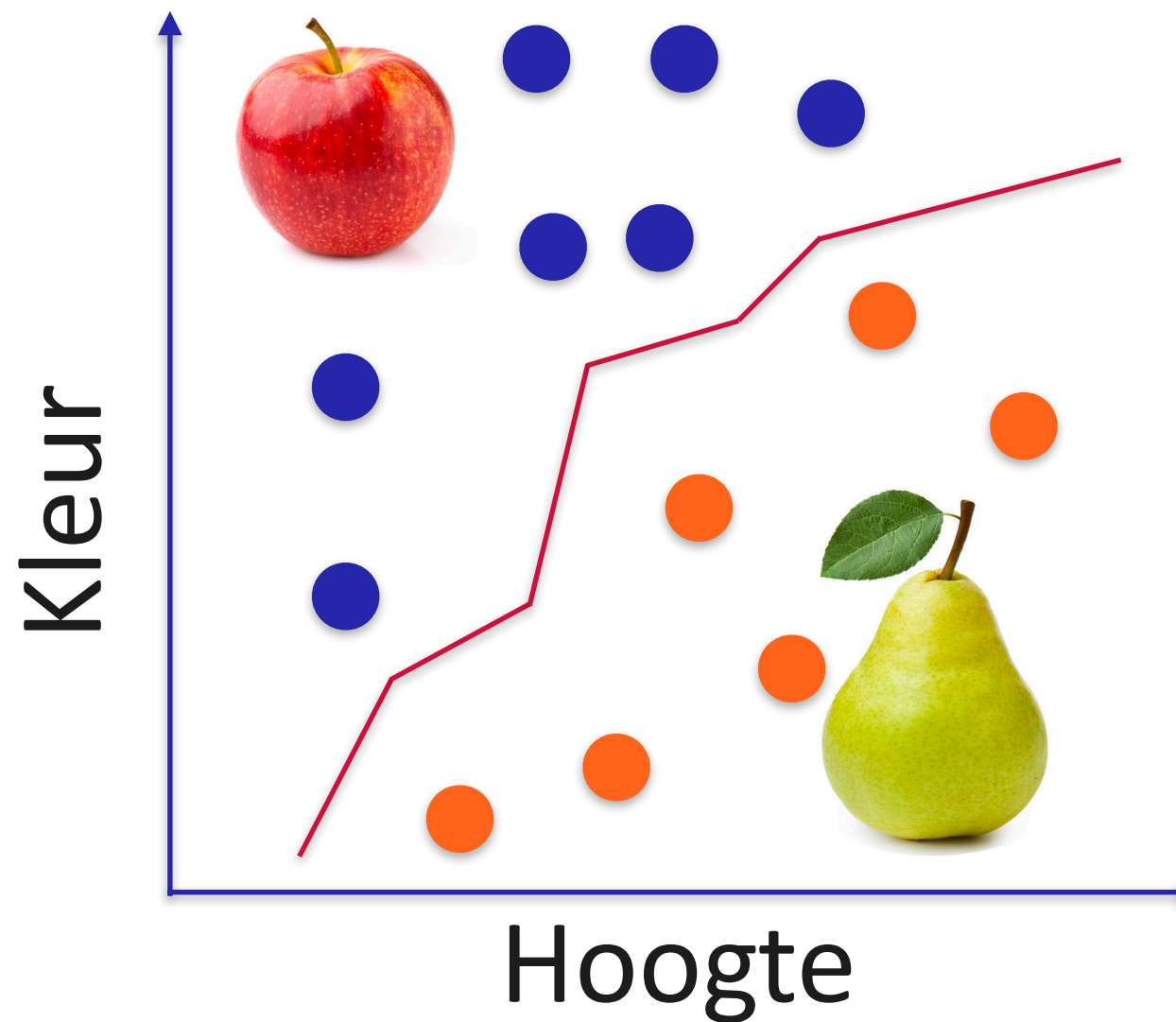


Hoe kunnen we van data leren?



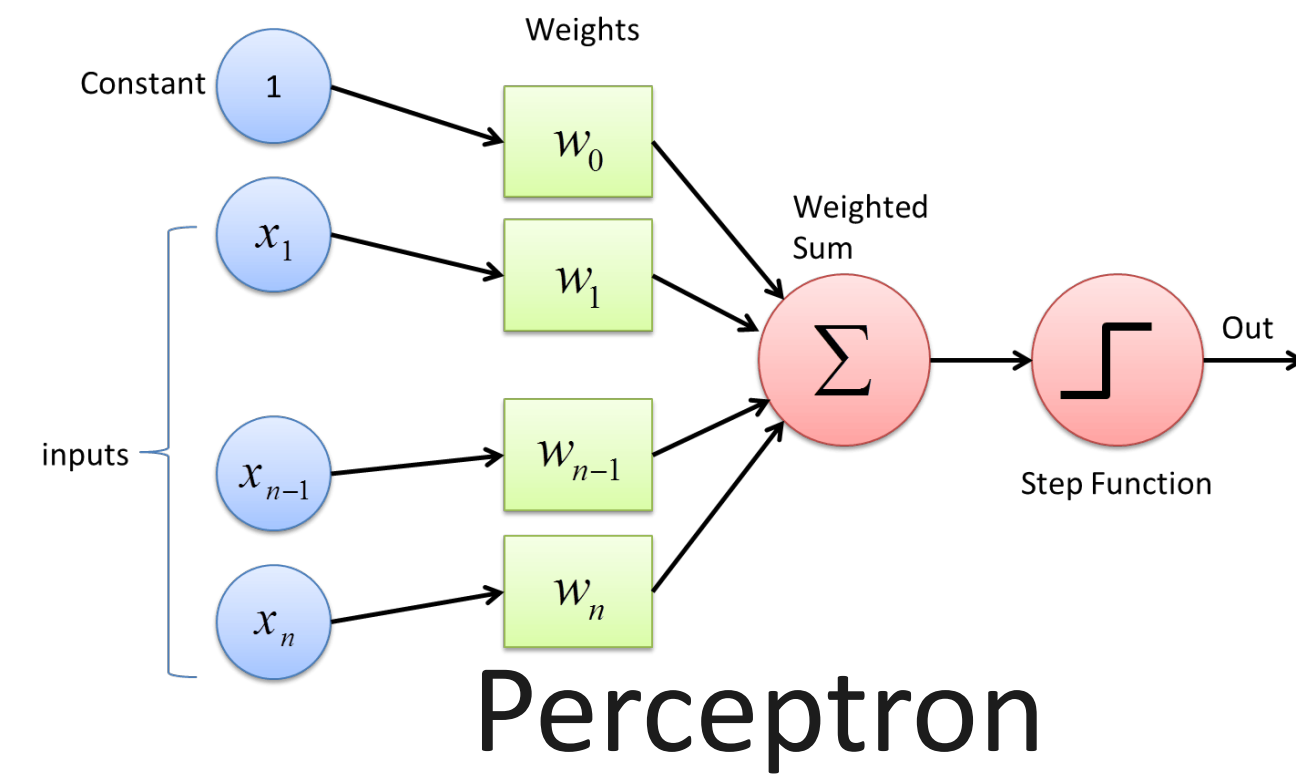
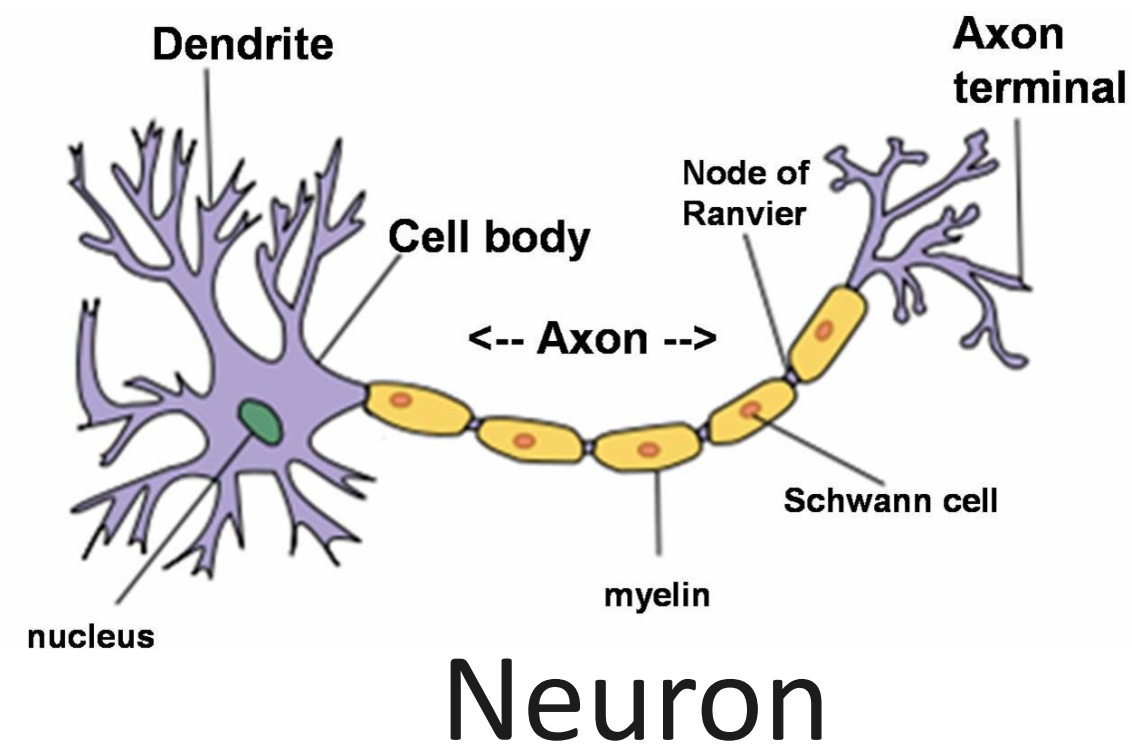
Metingen

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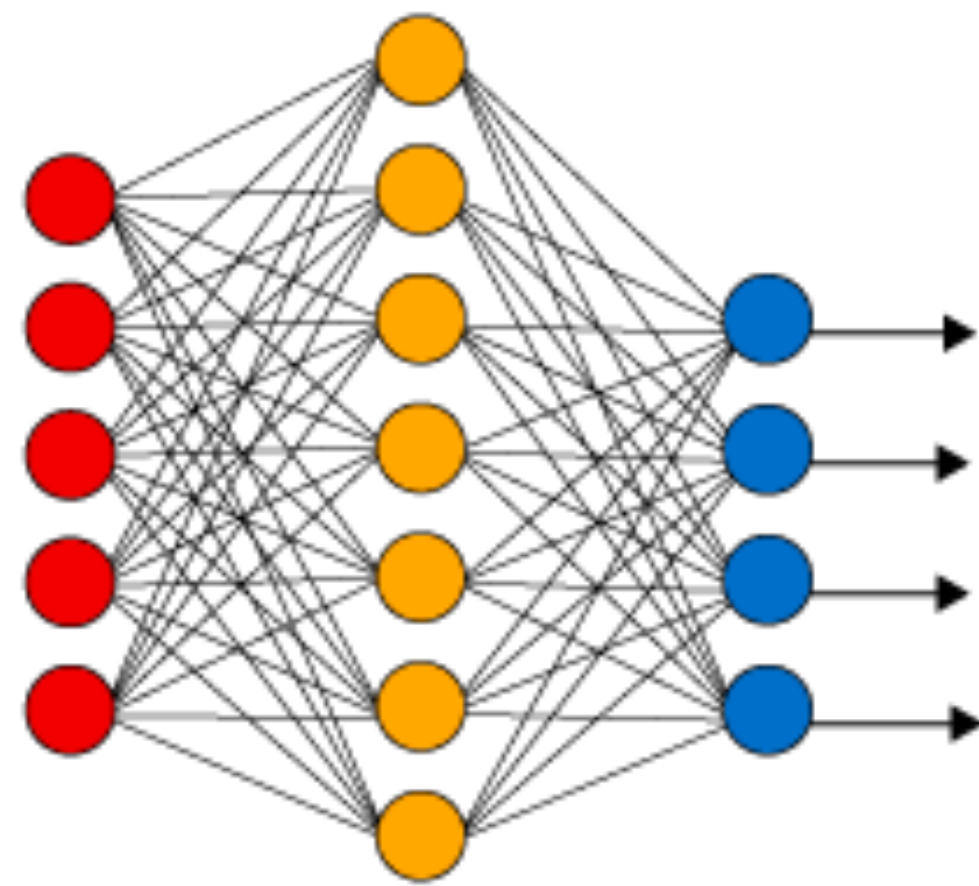


- Support Vector Machines
- Decision trees
- Random Forests
- Bayesian classifier
- Nearest Neighbor classifiers
- Lasso regression
- Ridge regression
- Elastic Net
- ...
- ...

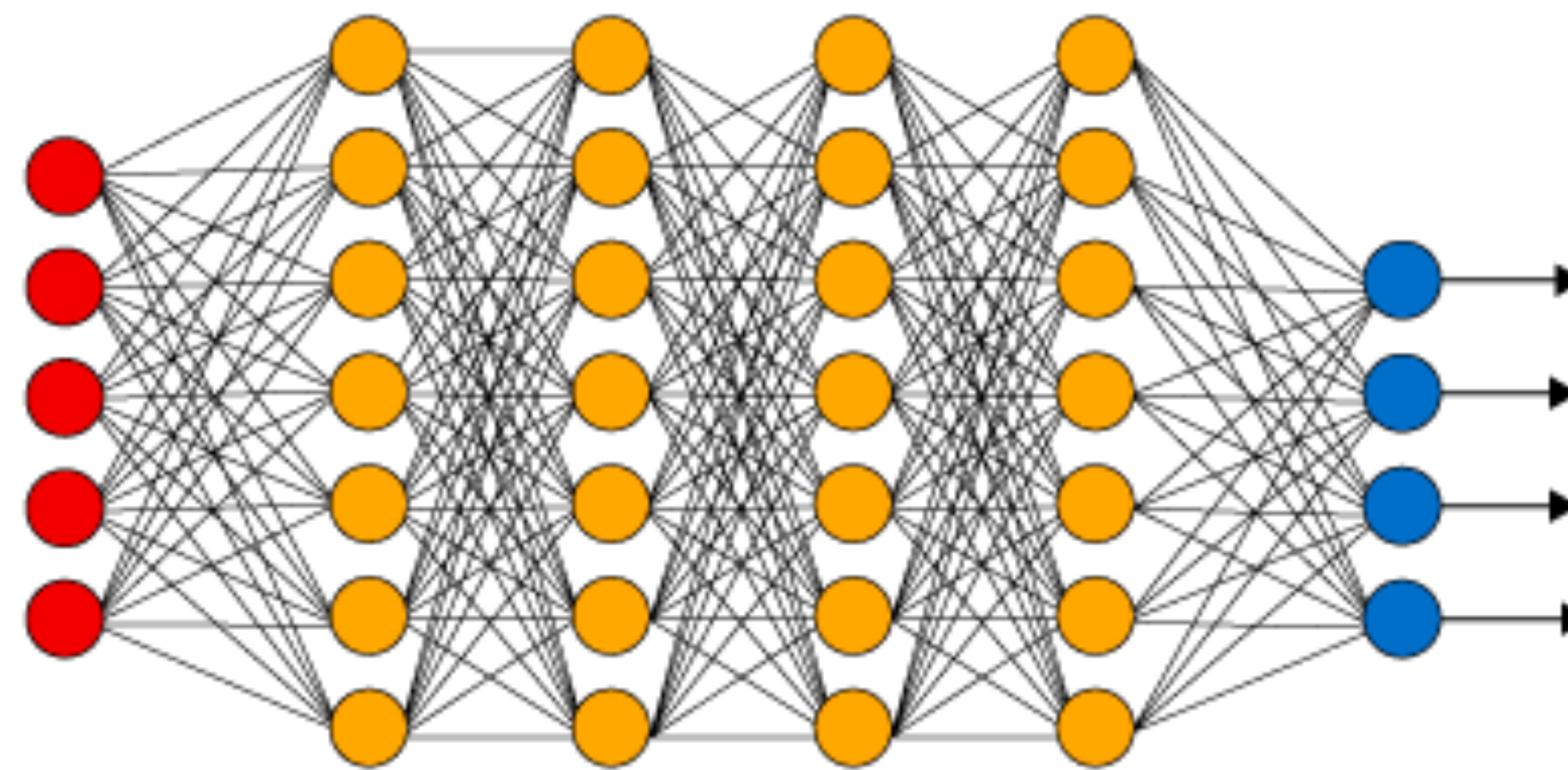
Deep learning (artificial neural networks)



Simple Neural Network



Deep Learning Neural Network

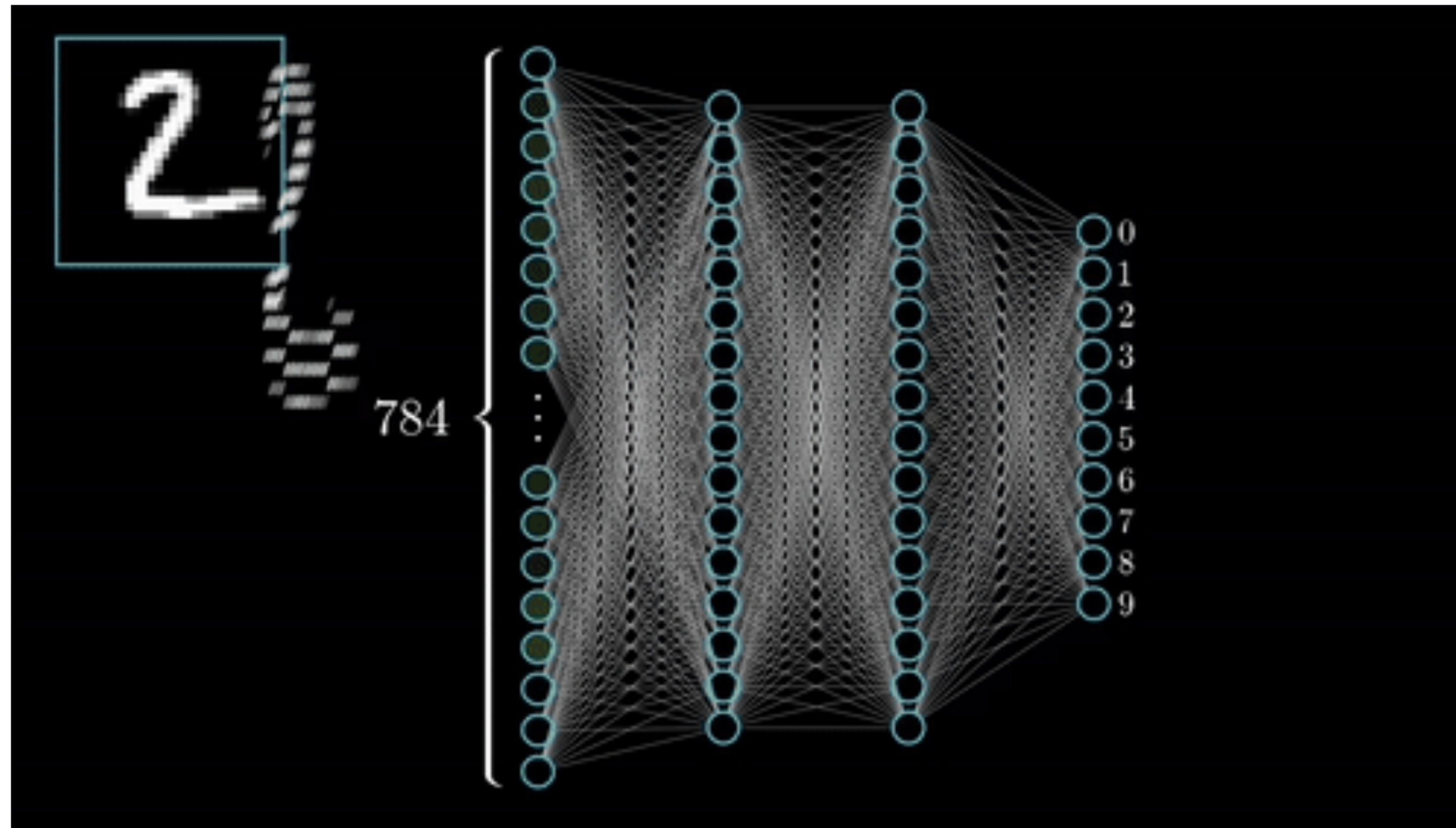


● Input Layer

● Hidden Layer

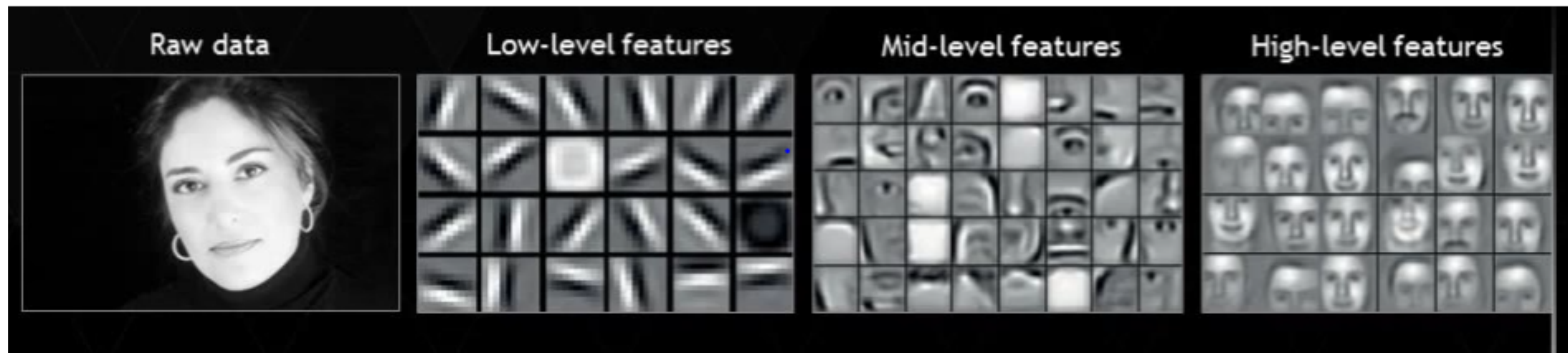
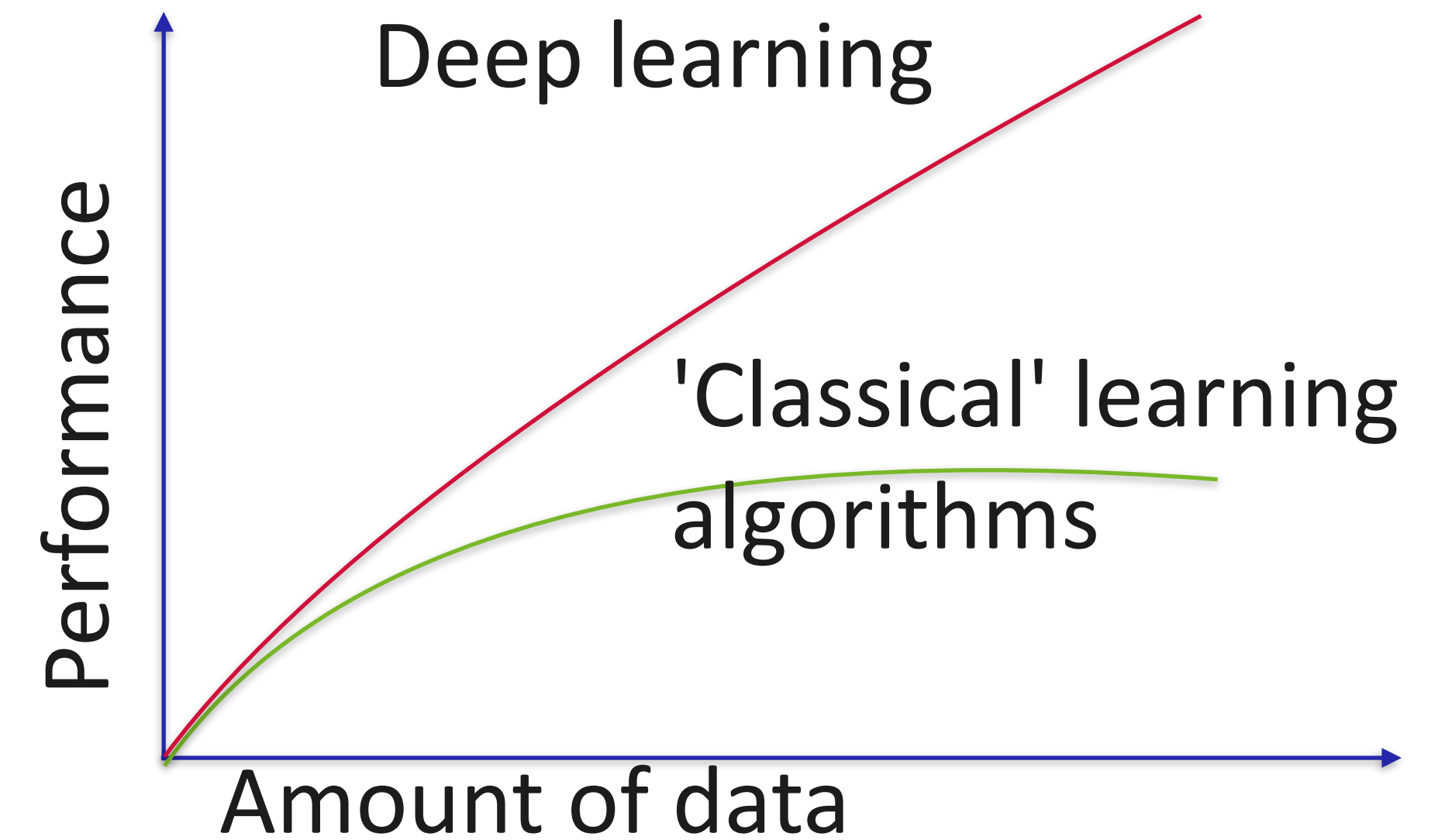
● Output Layer

Deep neural network in actie

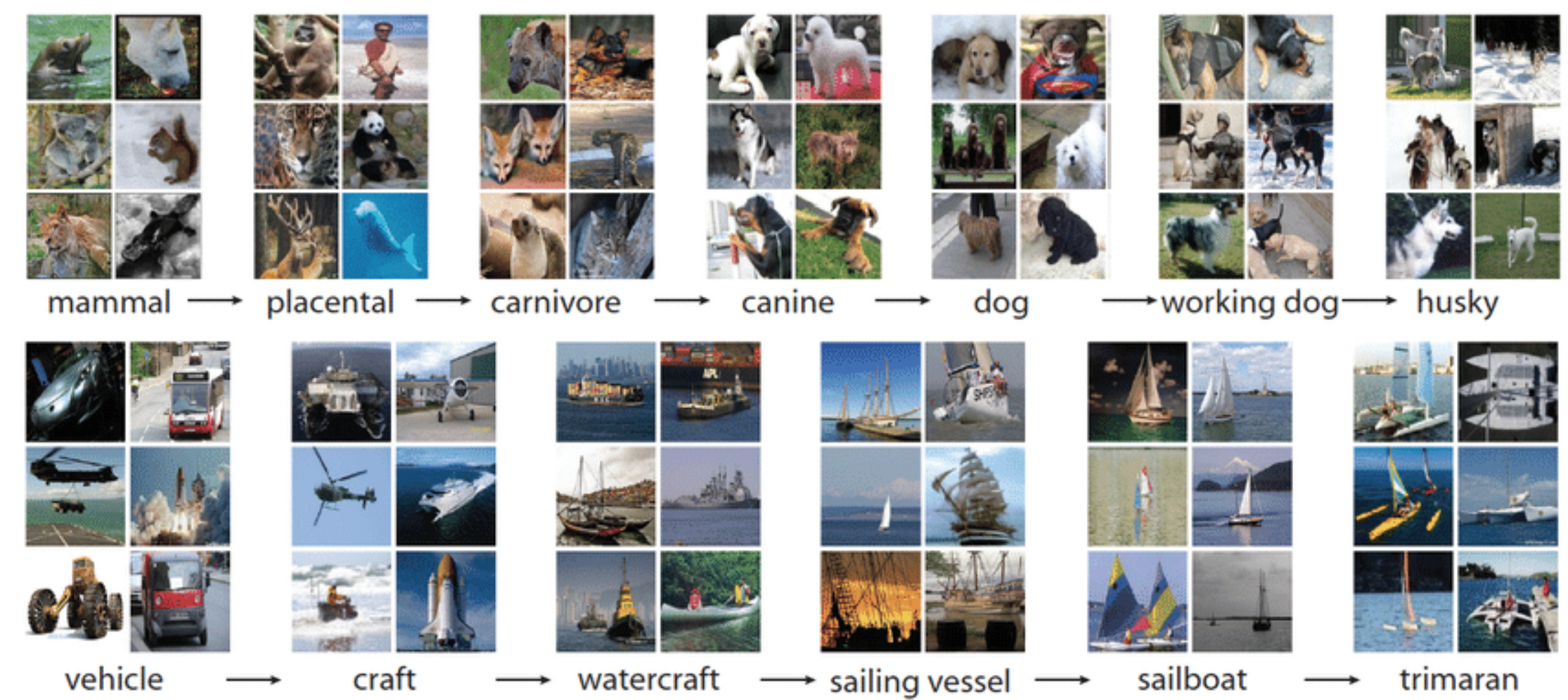
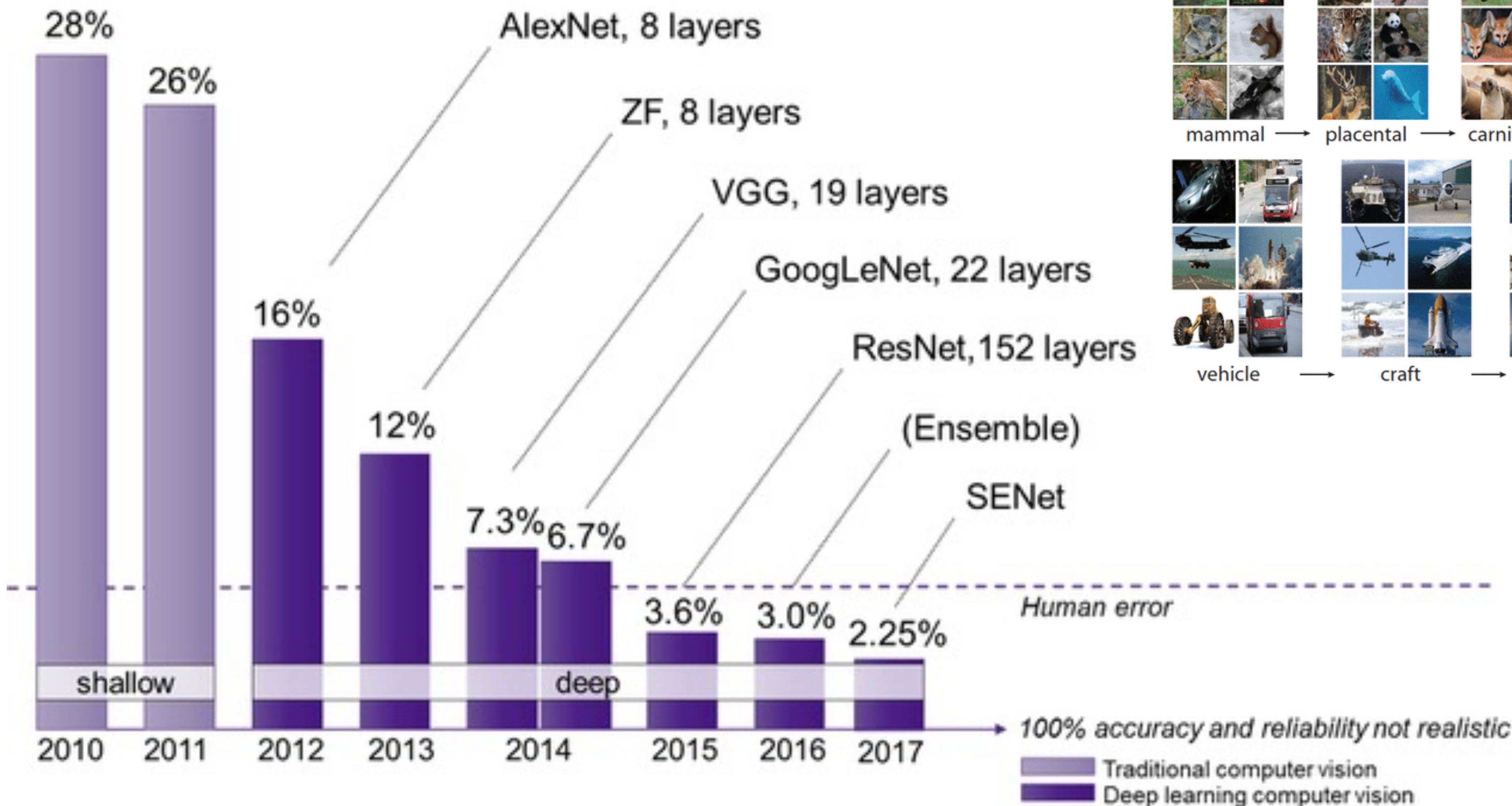


Waarom is deep learning zo'n 'game changer'?

- Meer data + rekenkracht = betere resultaten
- Leert 'automatisch' waar we op moeten letten



De stap vooruit: beeld herkenning



Self-supervised learning: ChatGPT



Yang, L., Chen, H., Li, Z., Ding, X., & Wu, X. (2023). ChatGPT is not Enough: Enhancing Large Language Models with Knowledge Graphs for Fact-aware Language Modeling. arXiv preprint arXiv:2306.11489.

Self-supervised learning door 'next-token prediction'

Text: Second Law of Robotics: A robot must obey the orders given it by human beings

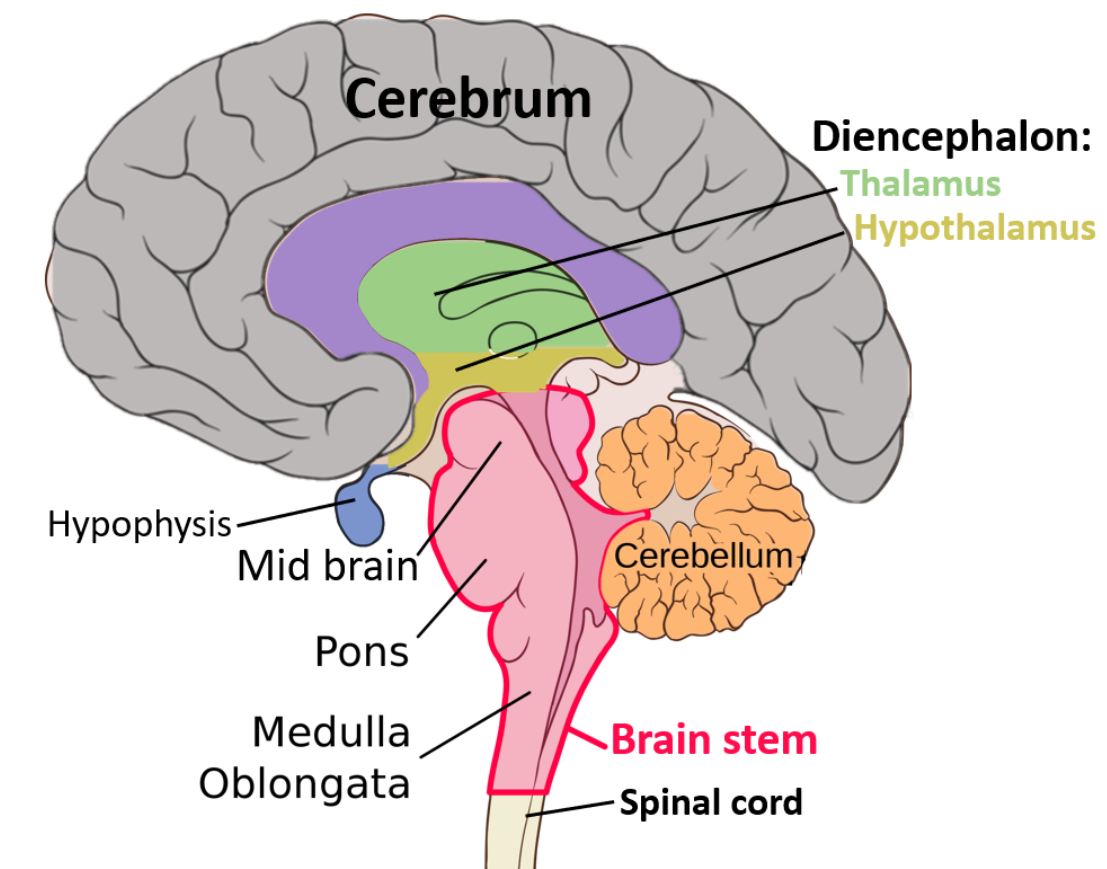


Generated training examples

Example #	Input (features)	Correct output (labels)
1	Second law of robotics :	a
2	Second law of robotics : a	robot
3	Second law of robotics : a robot	must
...		

What's in it for us?

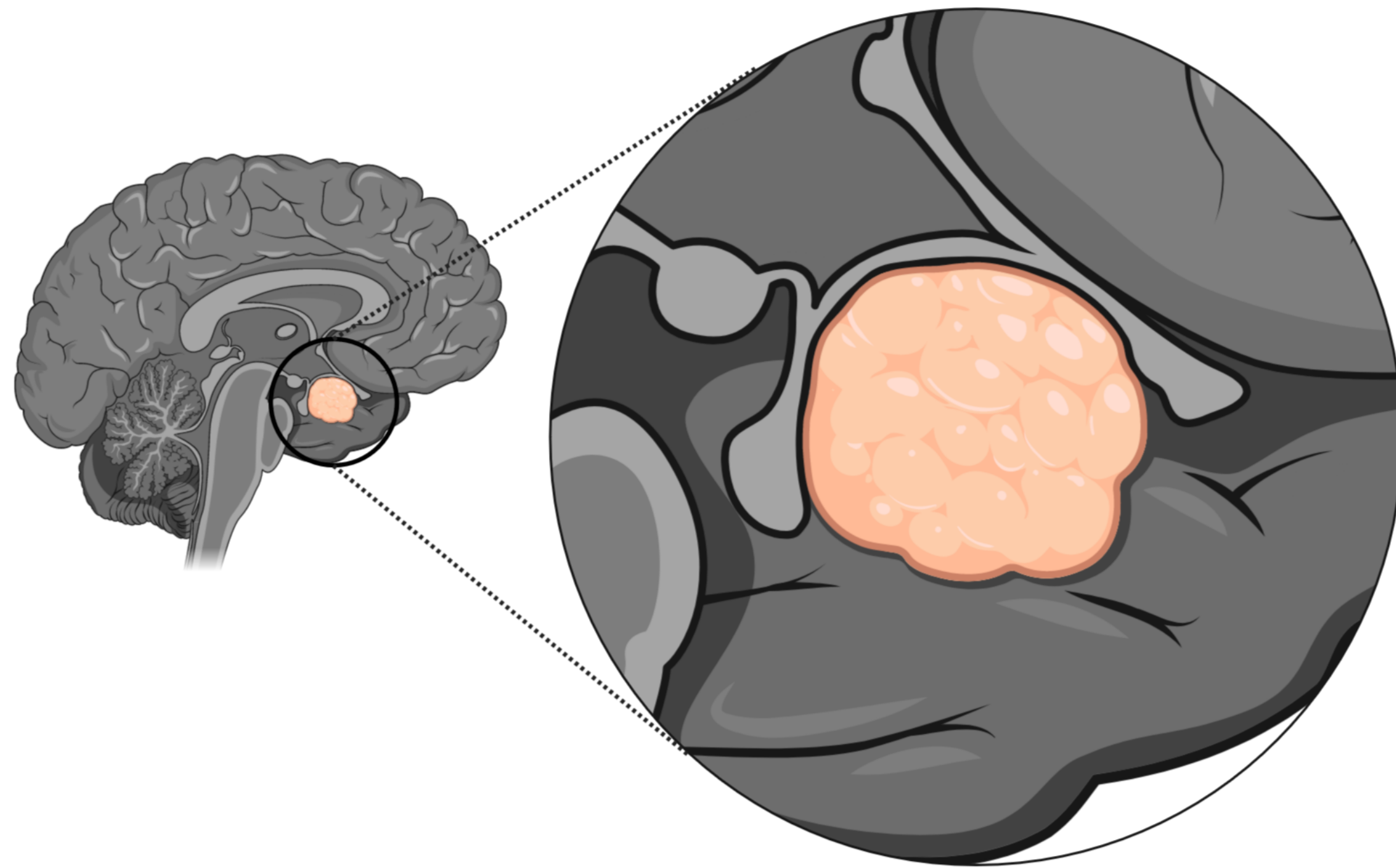
CNS tumoren bij kinderen



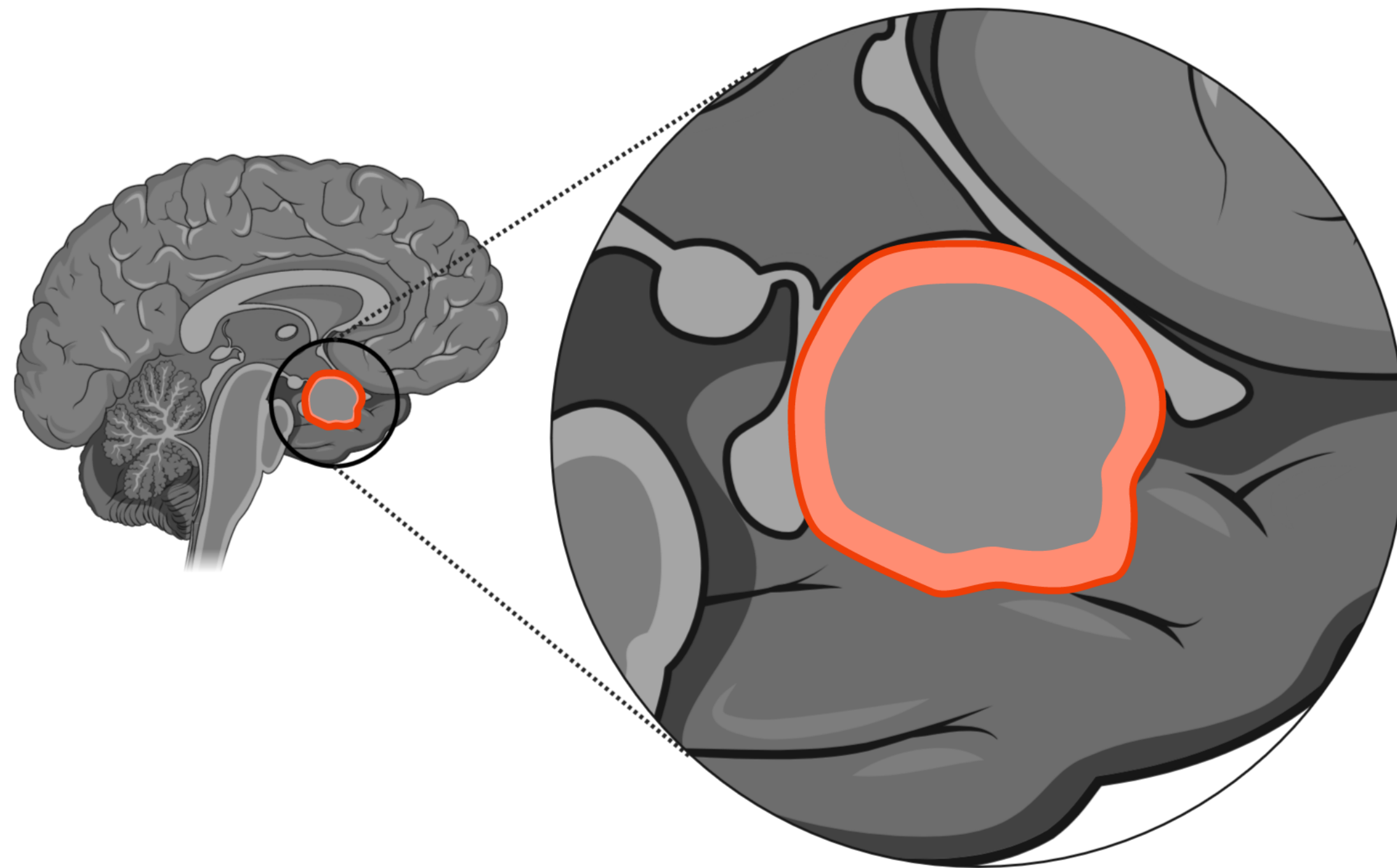
- Tumoren in de hersenen en centraal zenuw stelsel
- Meest dodelijke vorm van kanker bij kinderen
- Grote diversiteit aan tumor entiteiten

Tumor classification	Frequency as % of total CNS tumors
Pilocytic astrocytomas	~30%
Diffuse astrocytomas	~12%
Anaplastic astrocytomas	~2%
Glioblastomas	~3%
Oligodendroglial tumors	~1.5%
Ependymal tumor	~9%
Medulloblastomas	~20%
Pineal tumors	~1.5%
Meningeal tumors	~1.2%
Germ cell tumors	~3%

Chirurgische resectie



Eerste behandeling
chirurgische resectie

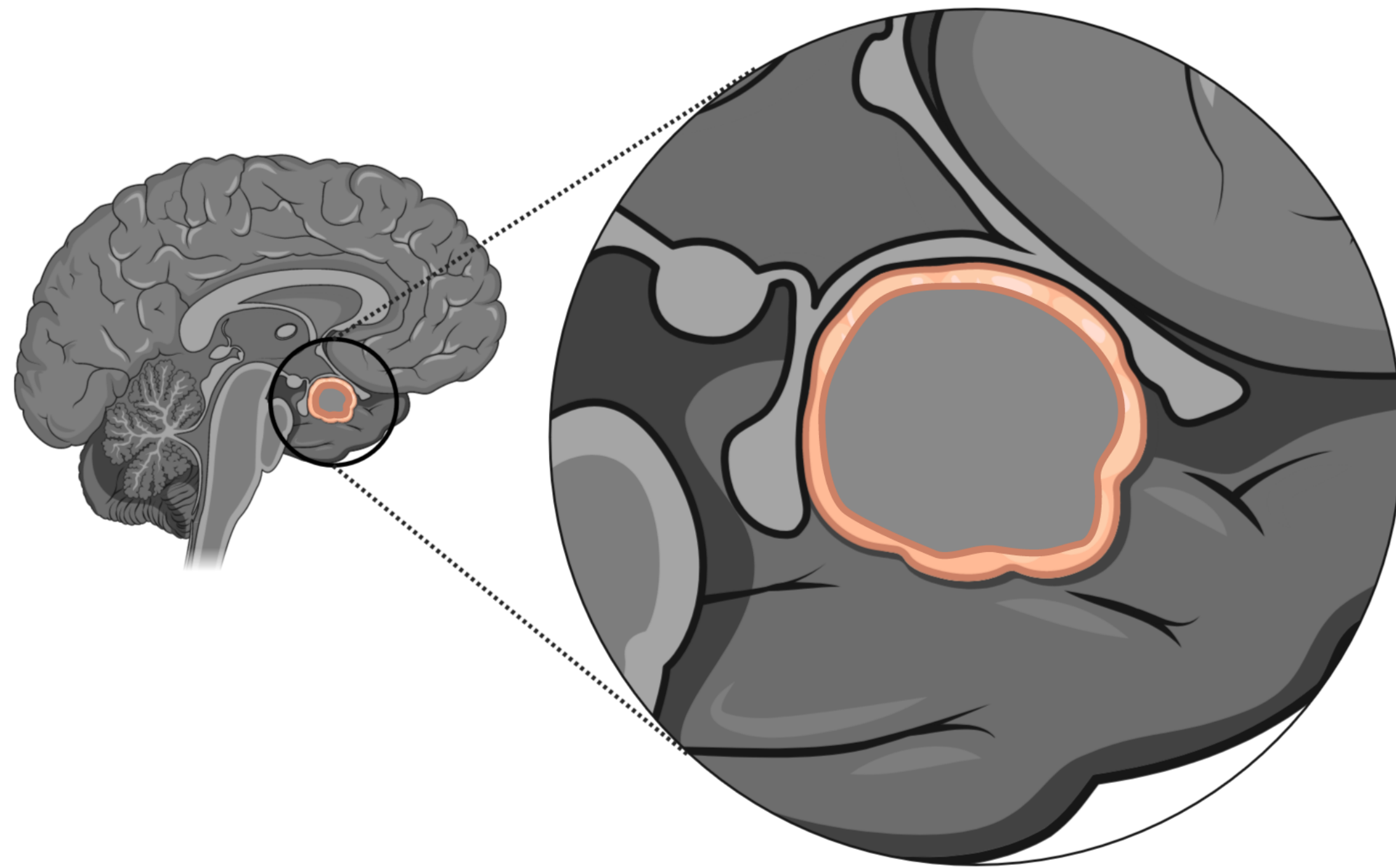


Hoe veel resectie is optimaal?

Agressieve tumor

Maximale resectie
(met mogelijk zeer nadelige
nevenschade)

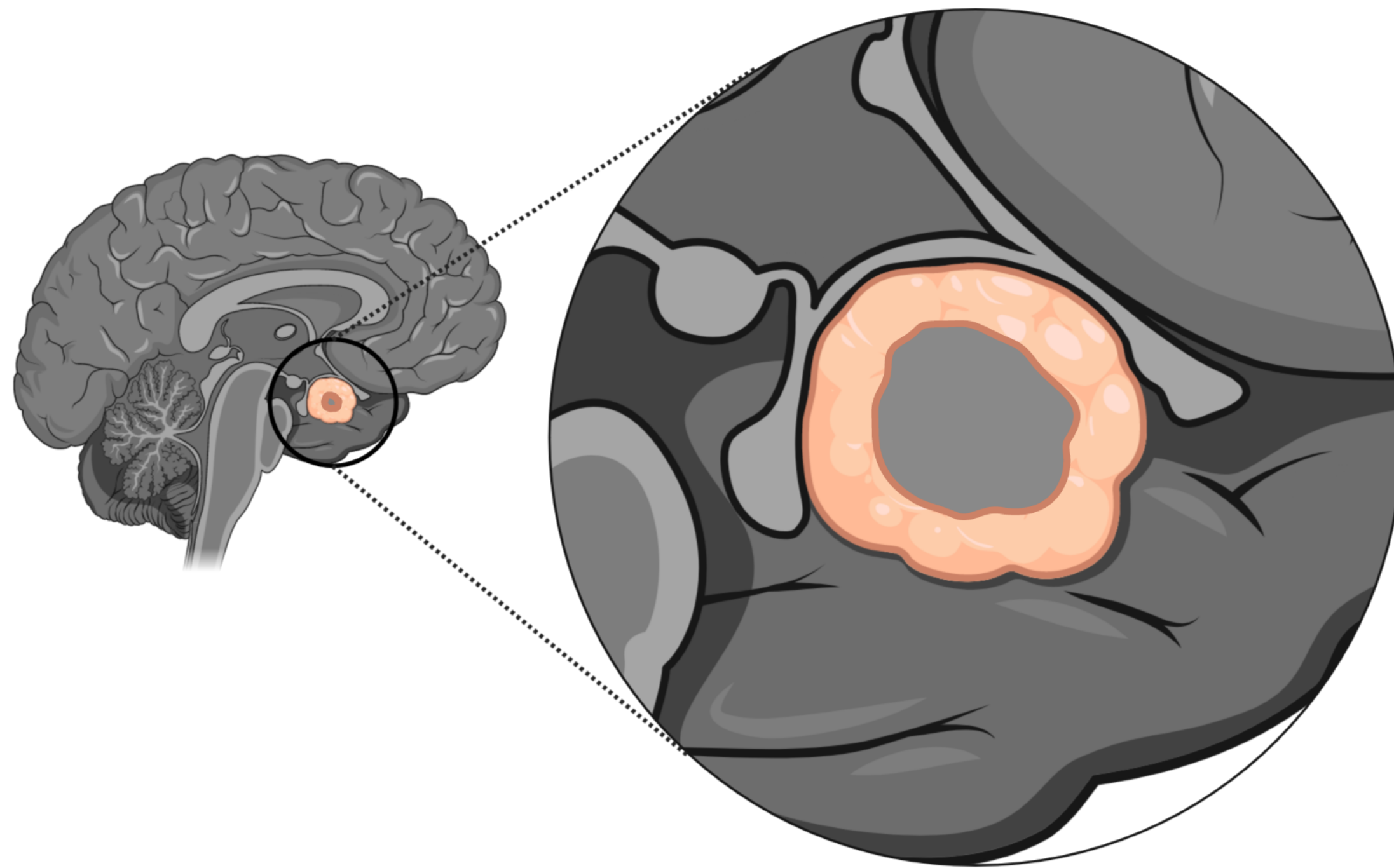
Chirurgische resectie



Hoe veel resectie is optimaal?

Goedaardig

Conservatieve resectie

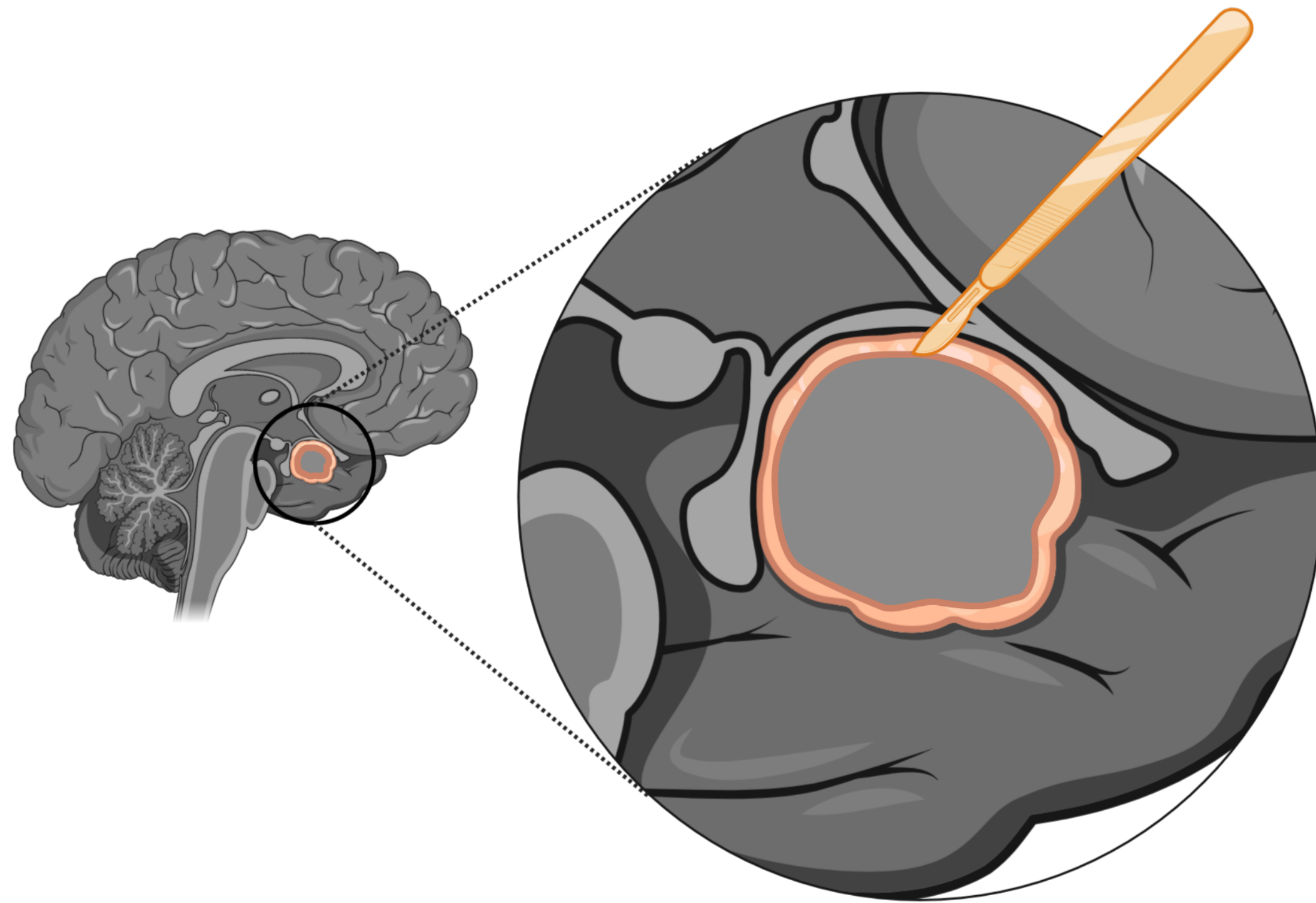


Hoe veel resectie is optimaal?

~~Goedaardig~~ **Agressief**

Conservatieve resectie
(Terugkerende tumor, 2e operatie)

Chirurgische resectie



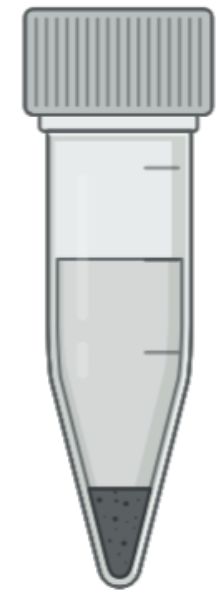
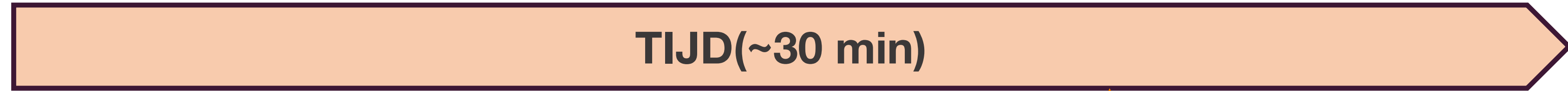
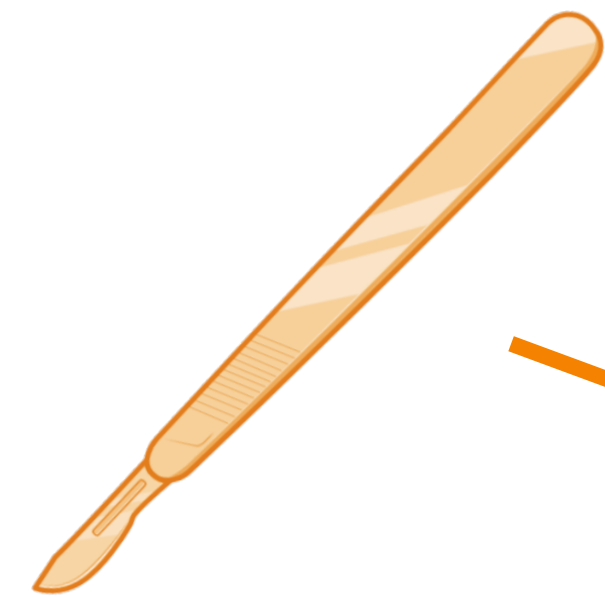
Hoe veel resectie is optimaal?

Medulloblastoma
Conservatieve resectie

Ependymoma
Maximale resectie

Intra-operatieve classificatie

Chirurgie



Sample
voorbewerking



Histologie

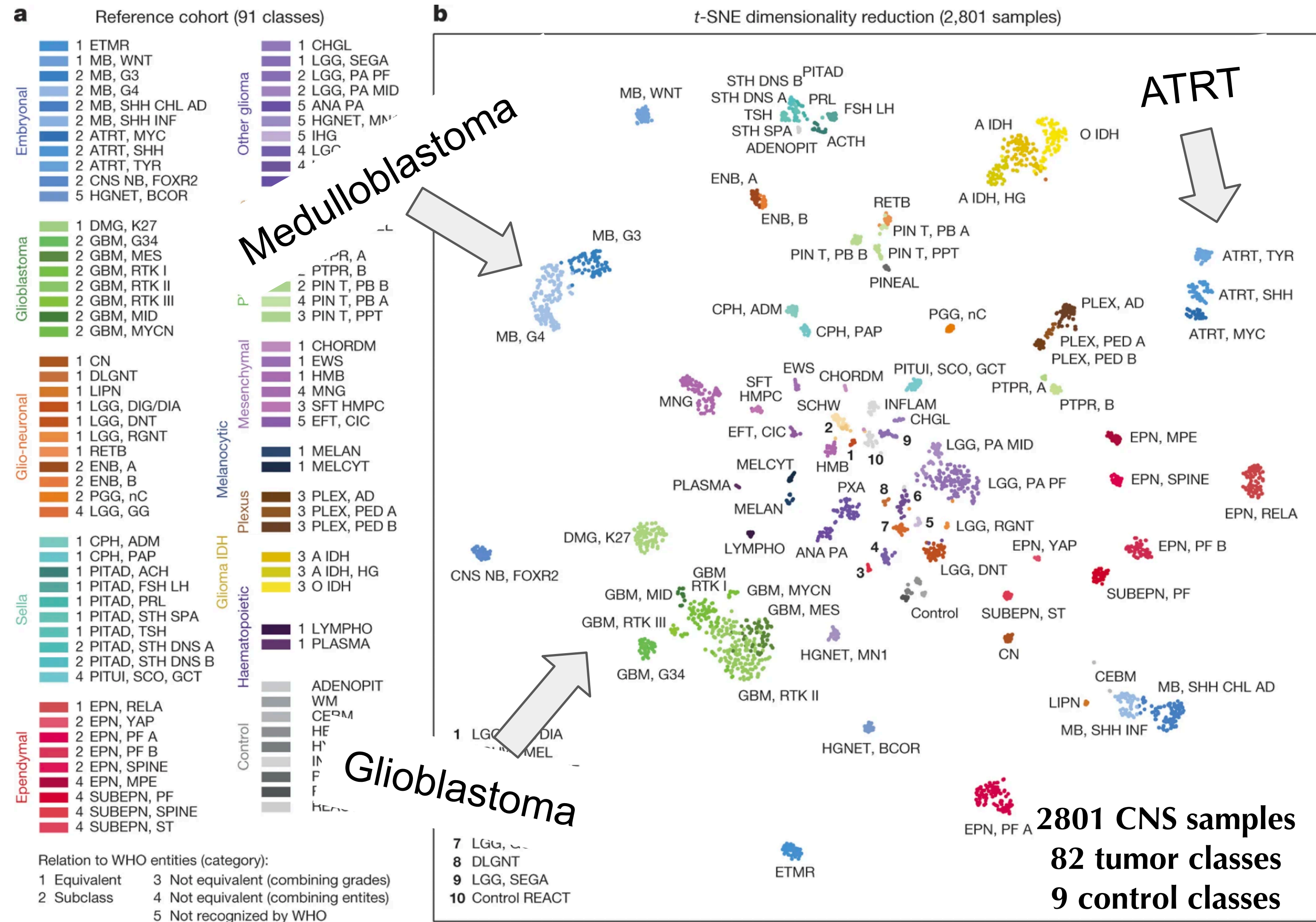


Patholoog

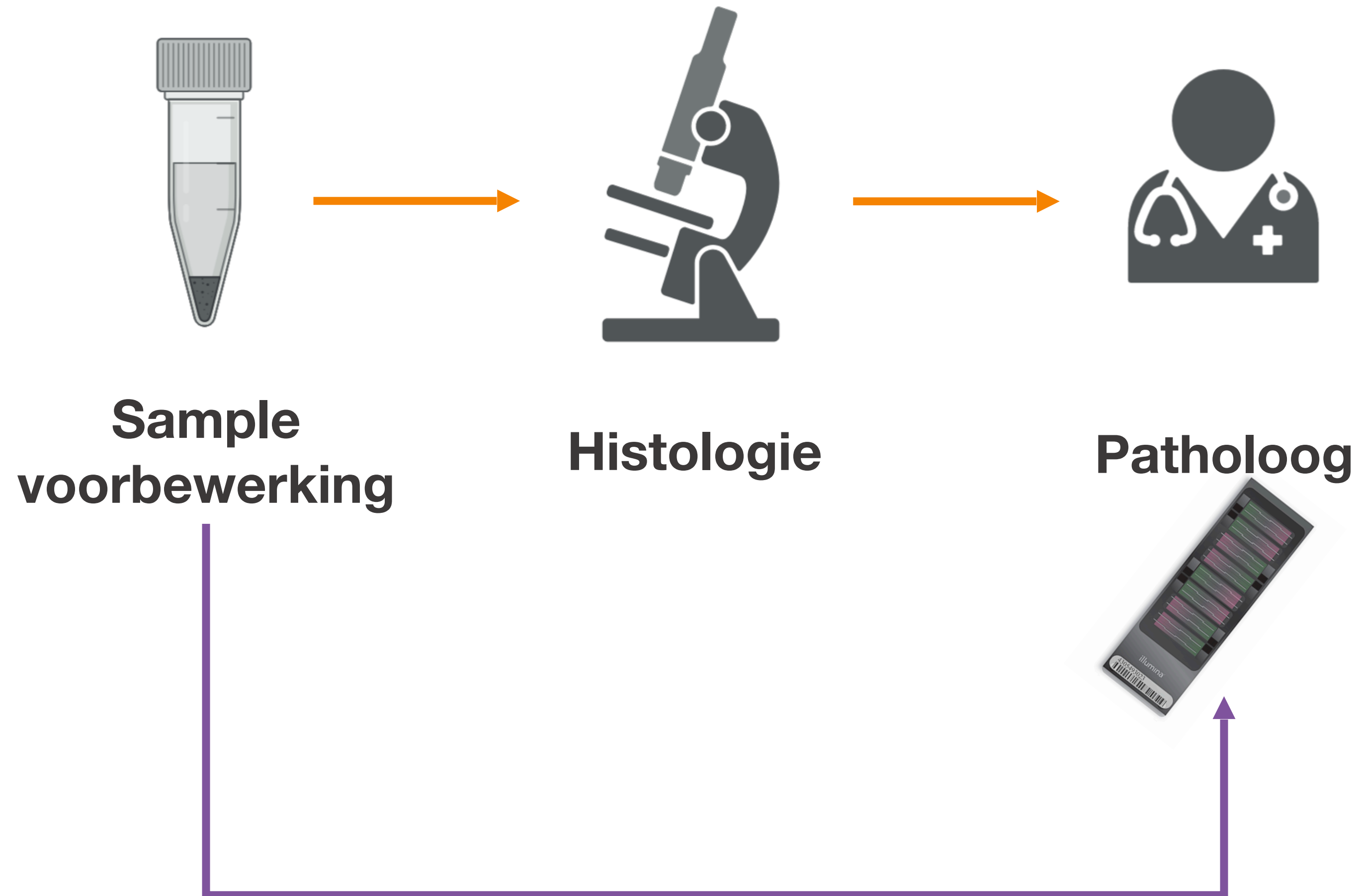
Geïnformeerde
chirurg

Ik denk een
Ependymoma

DNA profielen voor tumoren in het centraal zenuw stelsel



Post-operative classification



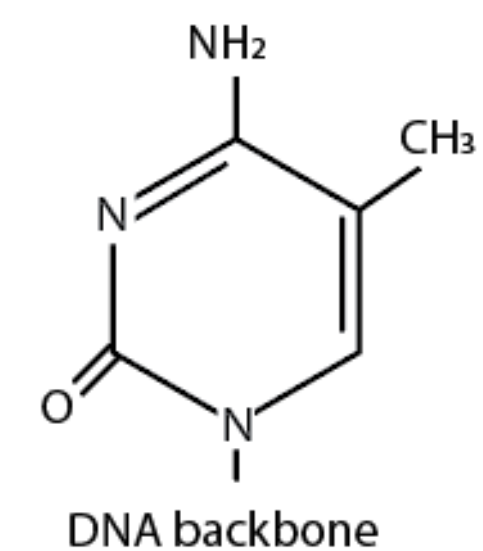
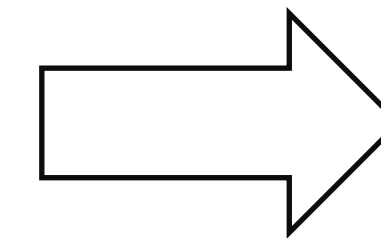
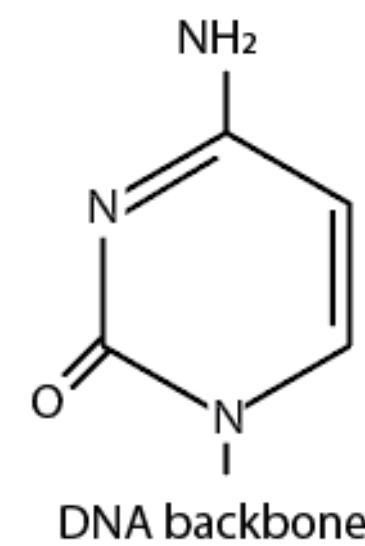


Nanopore sequencing



Eigenschappen

- Goedkoop
- Kan lange DNA moleculen in 1x meten
- Zeer snel resultaat
- Kan ook methylatie meten

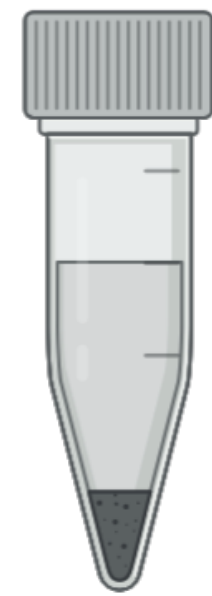
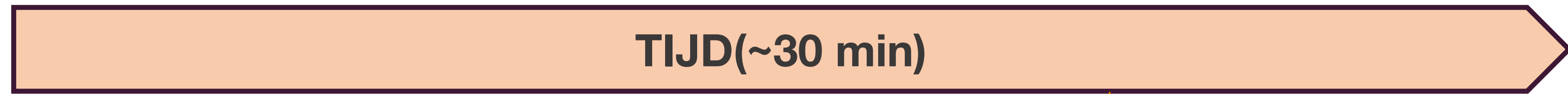
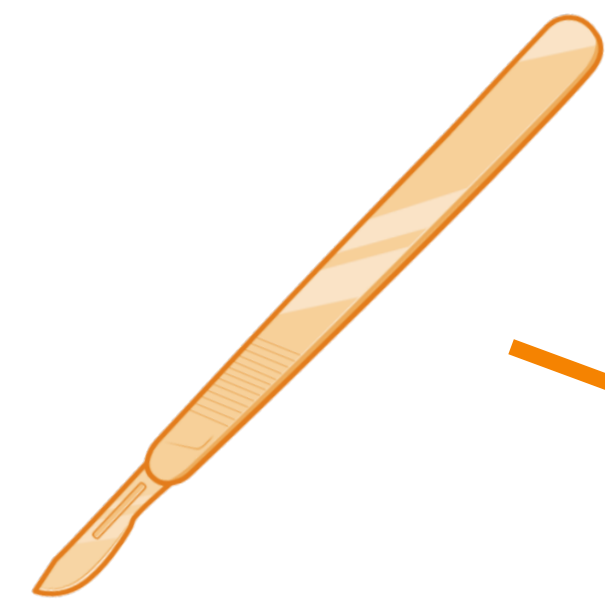


Cytosine

5-methyl-Cytosine

Intra-operatieve classificatie

Chirurgie



Sample
voorbewerking



Histologie

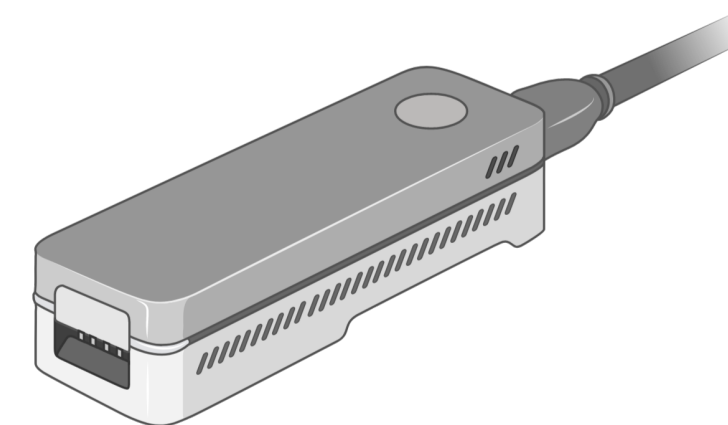


Patholoog

Geïnformeerde
chirurg

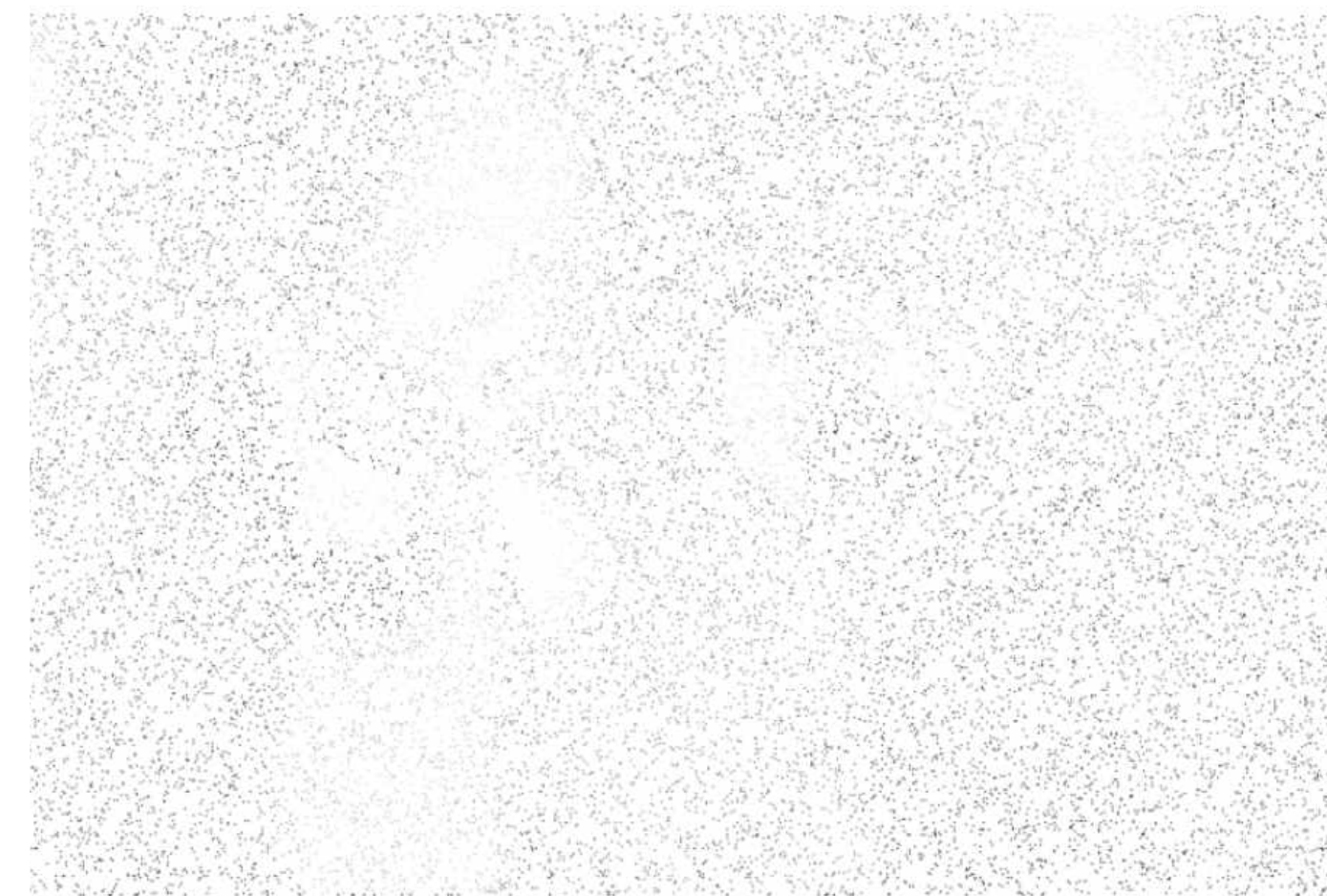
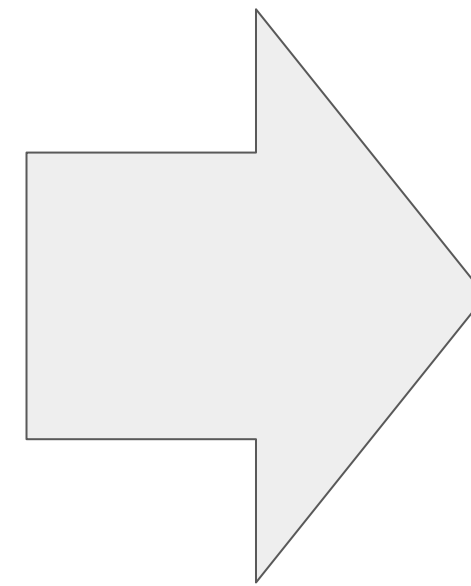
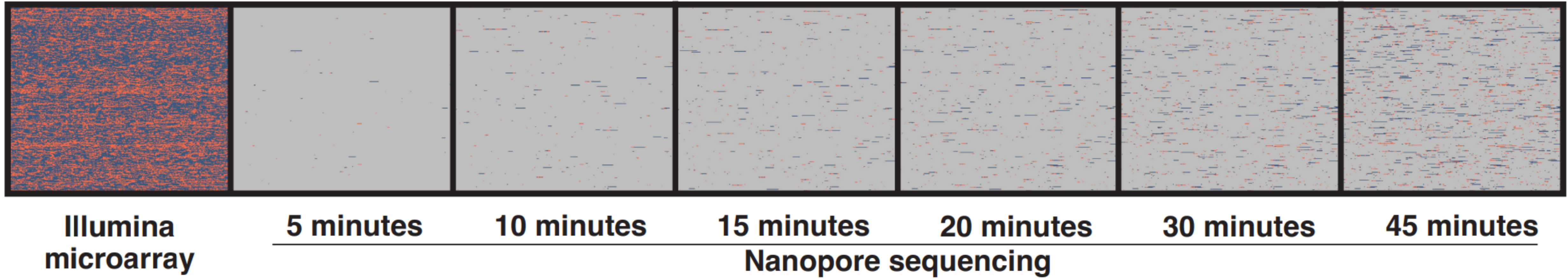
**Combined
diagnostics**

**Moleculaire
diagnose**



Zeer snelle DNA meting

De AI uitdaging: weinig data



Nanopore sequencing van biobank samples

Zekerheid -->

Ependymoma, posterior fossa group A



Tumor klasse -->

Atypical teratoid/rhabdoid tumor, subclass MYC



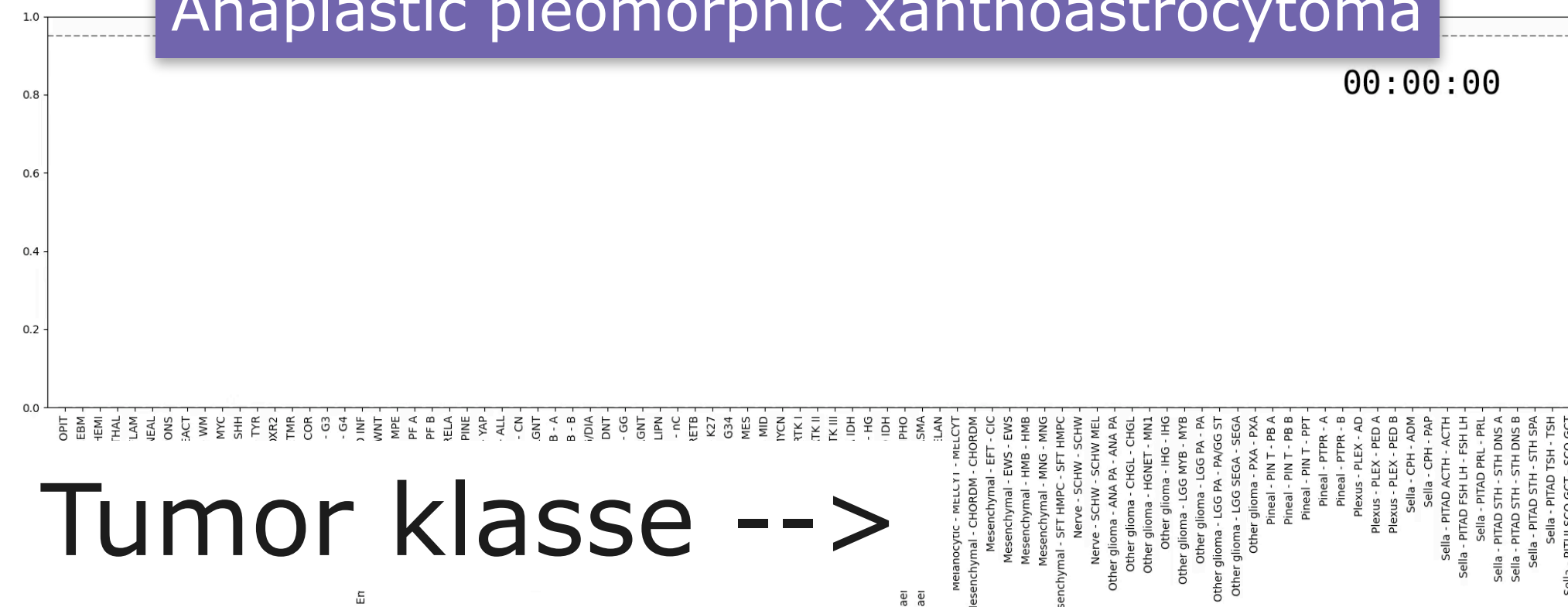
Tumor klasse -->

Diffuse midline glioma H3 K27M mutant



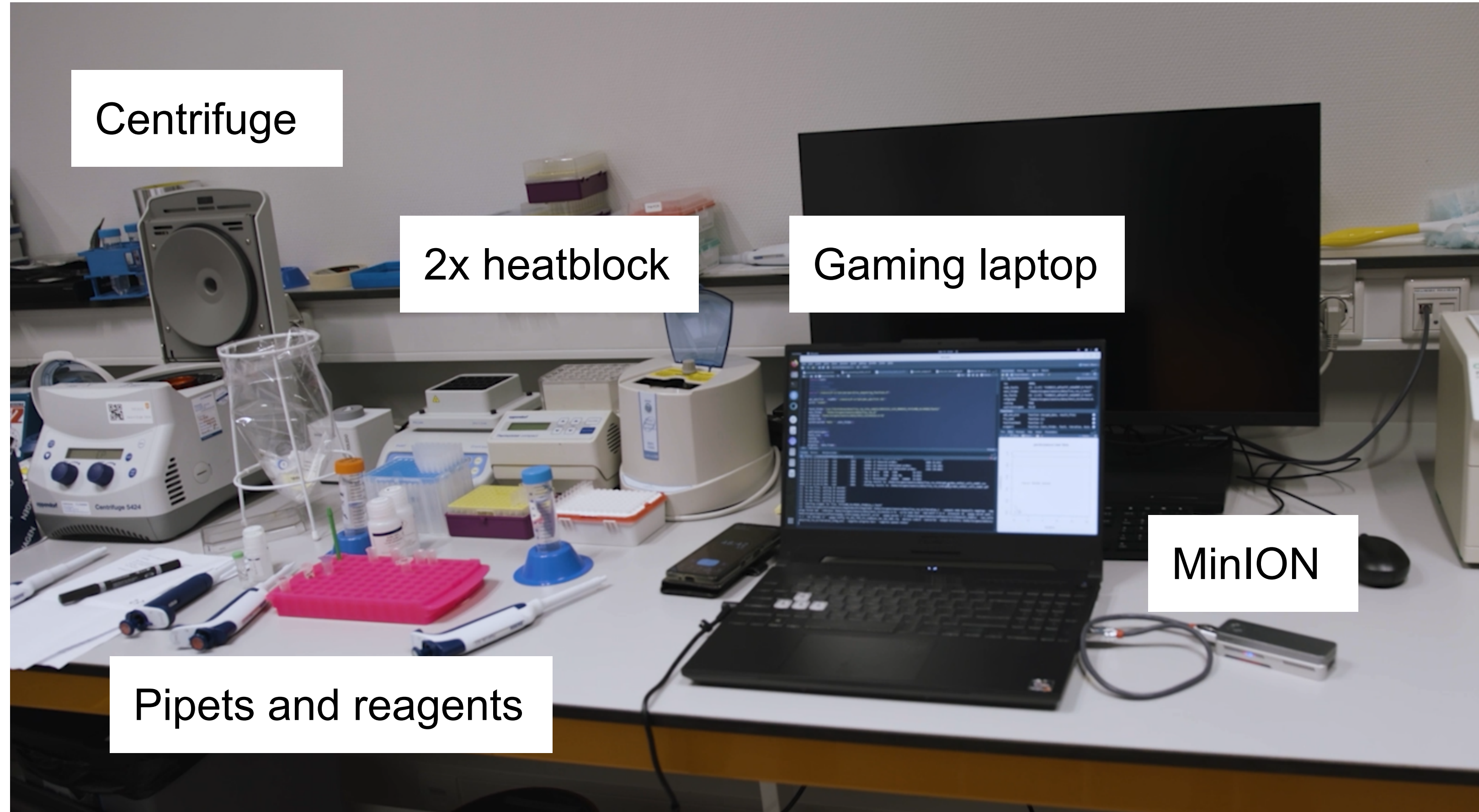
Tumor klasse -->

Anaplastic pleomorphic xanthoastrocytoma



Tumor klasse -->

Alles wat nodig is:

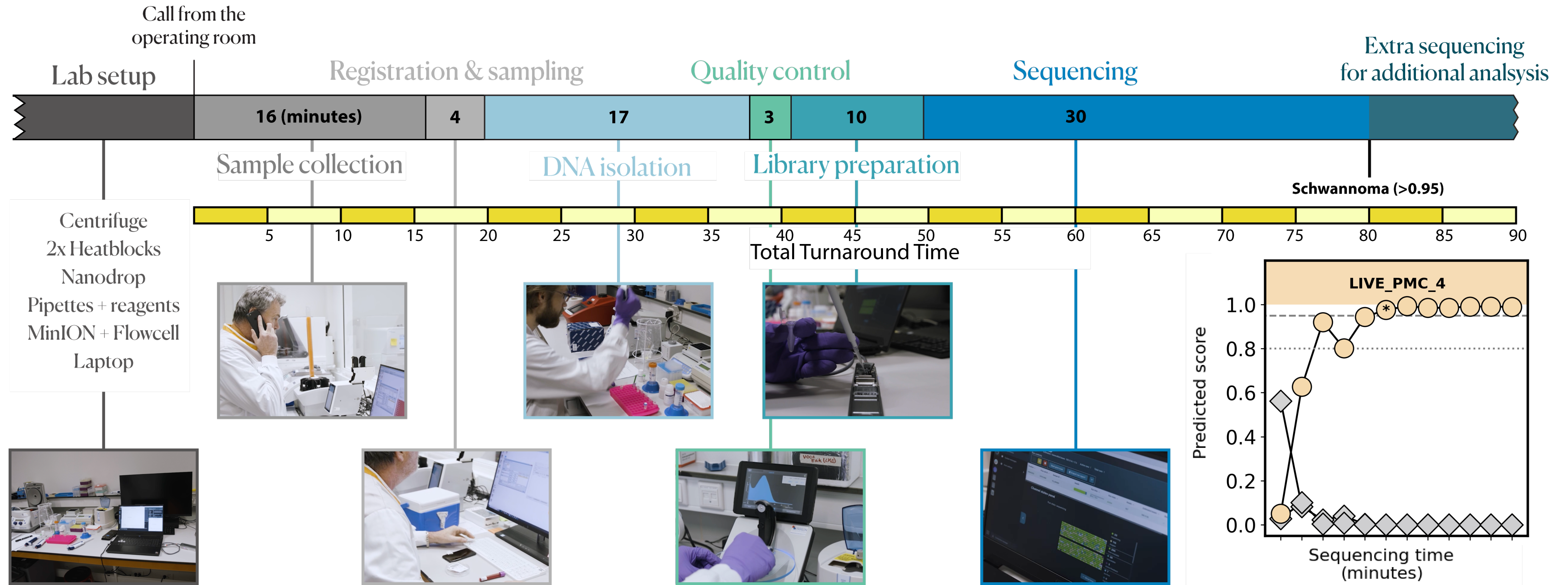


Live run



00:00	Collection
00:16	Registration
00:18	Cutting
00:19	DNA isolation
00:40	Library prep
00:50	Sequencing
01:00	First result

Intraoperative sequencing



Do it yourself

nature

Article

Ultra-fast deep-learned CNS tumour classification during surgery

<https://doi.org/10.1038/s41586-023-06615-2>

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Open access

 Check for updates


C. Vermeulen^{1,2,6}, M. Pagès-Gallego^{1,2,6}, L. Kester³, M. E. G. Kranendonk³, P. Wesseling^{3,4}, N. Verburg⁵, P. de Witt Hamer⁵, E. J. Kooi⁴, L. Dankmeijer^{4,5}, J. van der Lugt³, K. van Baarsen³, E. W. Hoving³, B. B. J. Tops³ & J. de Ridder^{1,2}

Central nervous system tumours represent one of the most lethal cancer types, particularly among children¹. Primary treatment includes neurosurgical resection of the tumour, in which a delicate balance must be struck between maximizing the



Source code of the Sturgeon prediction tool as a Python package can be found at:

<https://github.com/marcpaga/sturgeon>



PREMIUM SCIENCE

Meet Sturgeon, the AI tool that helps doctors identify brain tumors faster than ever

In the medical field, being fast, efficient, and correct can be the difference between life and death. This game-changing tool is helping cancer researchers and doctors save countless lives.

By Chris Gayomali
October 15, 2024

U.S. INTERNATIONAL CANADA ESPAÑOL 中文

The New York Times

New A.I. Tool Diagnoses Brain Tumors on the Operating Table

A new study describes a method for faster and more precise diagnoses, which can help surgeons decide how aggressively to operate.

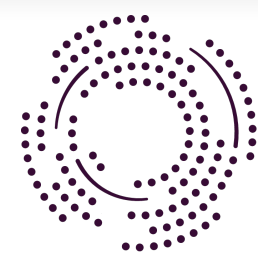


Machine can identify brain tumours during surgery

Tom Whipple Science Editor

Rapid desktop DNA readers could allow doctors to identify brain tumour

cer is made by the UK company Oxford Nanopore. It is able to provide a rapid readout of DNA using a machine small enough to be held in an



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The lab

Roy Straver	Carlo Vermeulen
Myrthe Jager	Dieter Stoker
Claudio	Michiel Thiecke
Lucia Barbadilla Martinez	Franka Rang
Marta Gonzalez	Huub van der Ent
Joske Ubels	Carlos Garcia Fernandez
Tristan Achterberg	Ahmadreza Iranpour
Merel Jongmans	Amalia Tsakali
Jack Jiang	Claudio Novella Rausell
Cristian Ruiz Moreno	



Marc Pagès-Gallego
Bastiaan Tops
Lennart Kester
Pieter Wesseling
Mariëtte Kranendonk
Jasper van der Lugt
Eelco Hoving
Eric Strengman
Kirsten van Baarsen



Niels Verburg
De Witt Hamer
Evert-Jan Kooij
Lucas Dankmeijer



Wigard Kloosterman
Alessio Marcozzi
Dami Rebergen

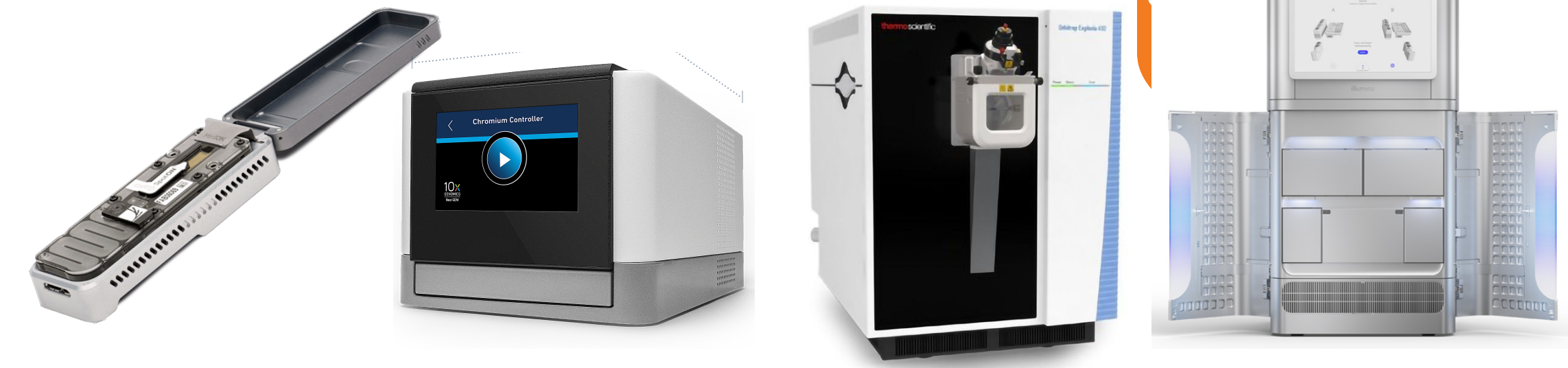


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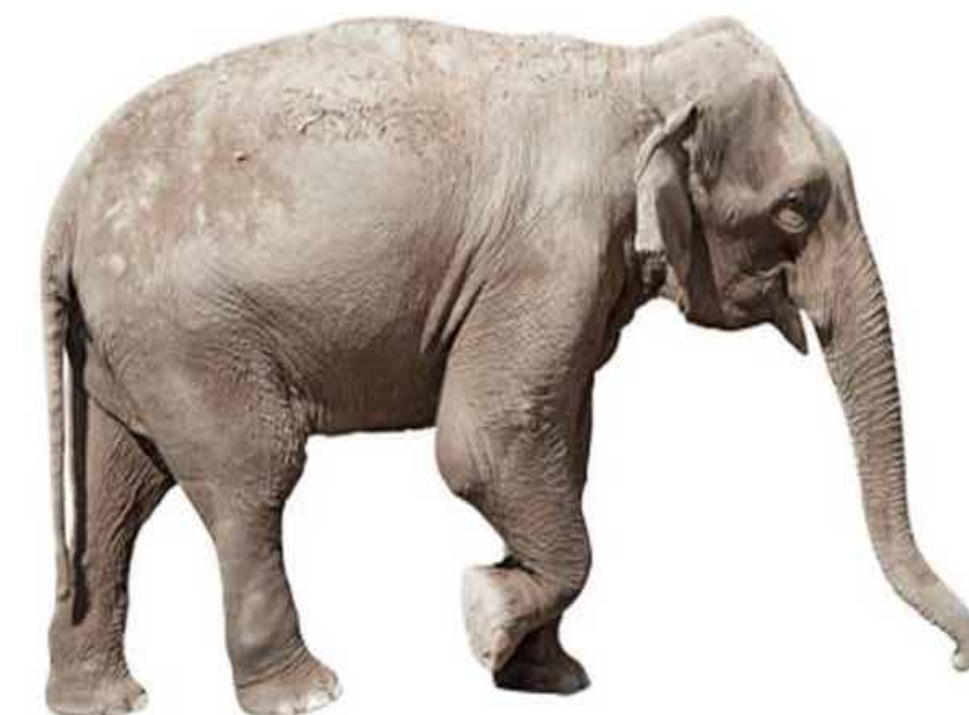
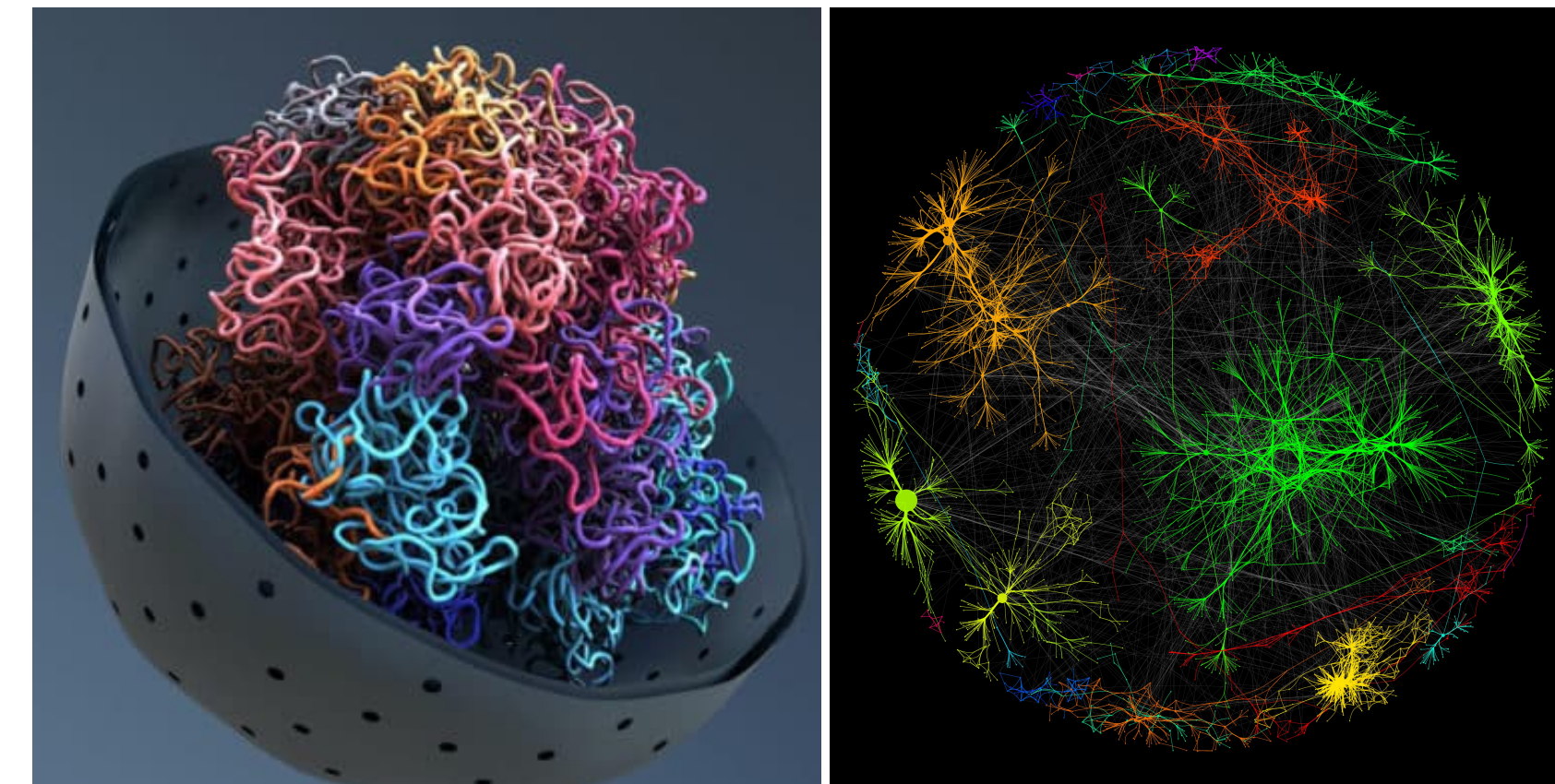




In de kanker biologie gebruiken we moleculaire data...



Moleculaire data zijn veel complexer dan beelden...



Beeld data

En de hoeveelheid data om van te leren is inherent beperkt...



Moleculaire data