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GEILO WINTER SCHOOL 2021 - EXPLAINABLE ALGORITHMS

Explainable Algorithms

- What is an algorithm?
  - “a process or set of rules to be followed in calculations or other problem-solving operations, especially by a computer” (definition from Oxford Languages)
- What do we mean by explainable?
  - Explanation depends on the receiver
- Understand how an algorithm can be efficient, robust and comprehensible at the same time

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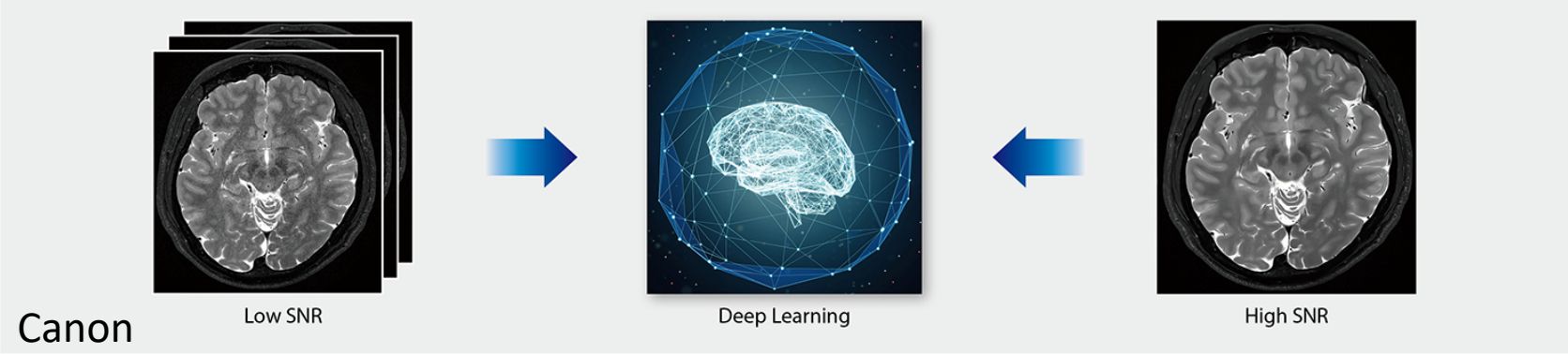
Fictive MRI example



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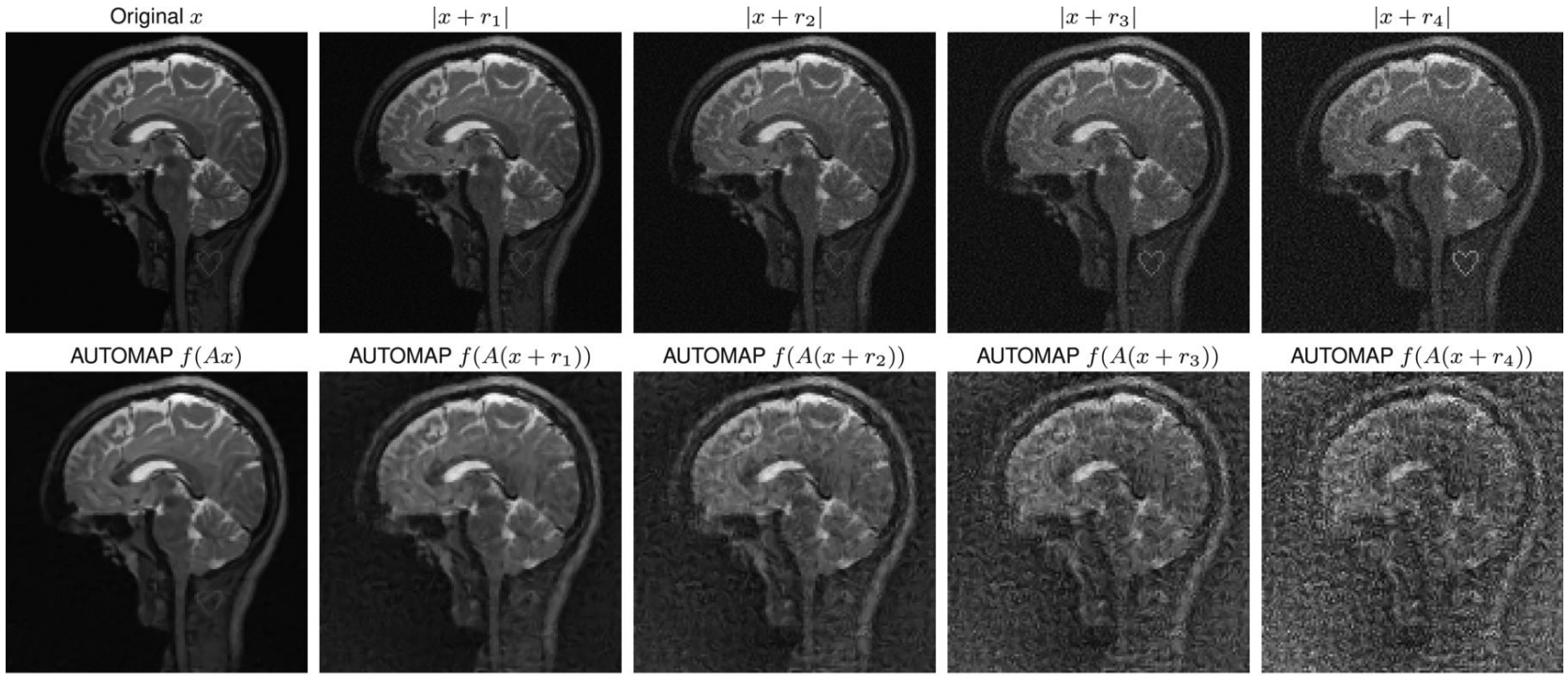
Stability issues

Time	Jan 25	Jan 26	Jan 27	Jan 28	Jan 29
10:00-11:30				4.2 Langseth	
12:00-13:30	Opening Session	3.1 Strümke	3.2 Strümke		1.3 Antun/Colbrook
13:30-15:00	1.1 Antun/Colbrook	Poster 1	Poster 2	Poster 3	
15:00-16:30		1.2 Antun/Colbrook	4.1 Langseth	5.1 Karpatne	5.2 Karpatne
16:30-18:00	2.1 Raissi				Closing Session



Antun et al. 2020

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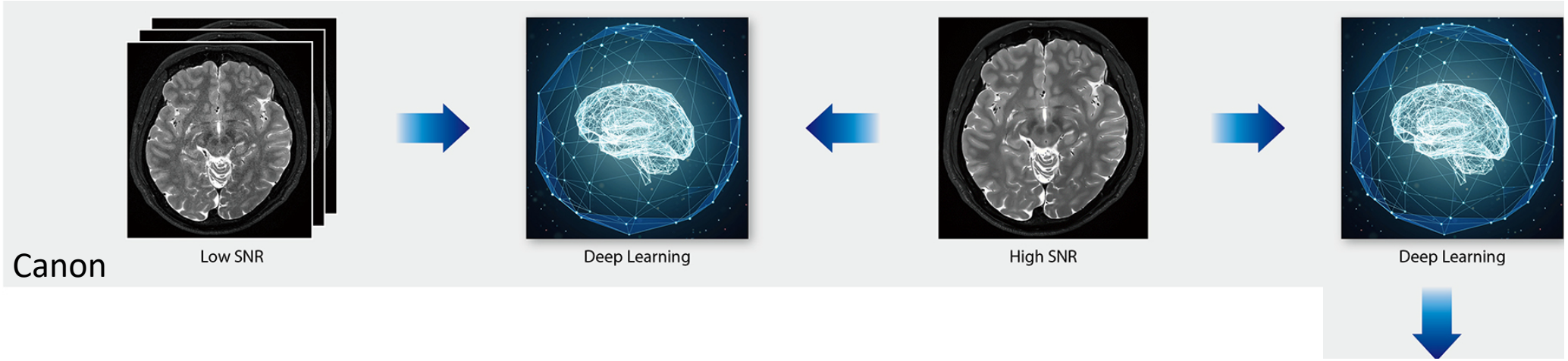
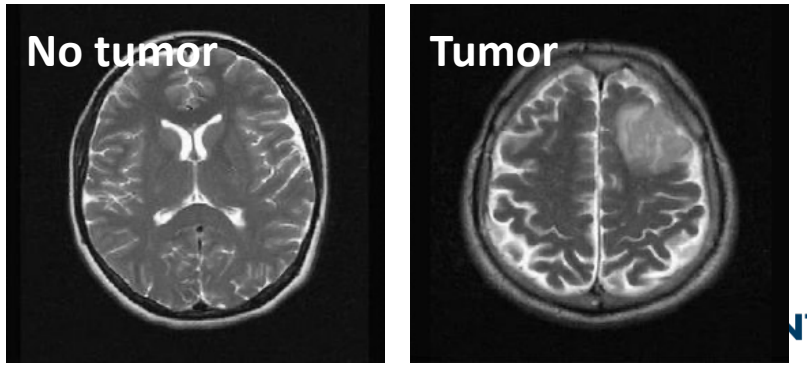
Example on identifying tumors





Probabilistic AI

Time	Jan 25	Jan 26	Jan 27	Jan 28	Jan 29
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12:00-13:30	Opening Session	3.1 Strümke	3.2 Strümke		1.3 Antun/Colbrook
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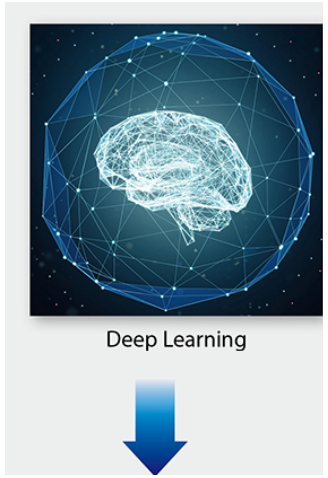
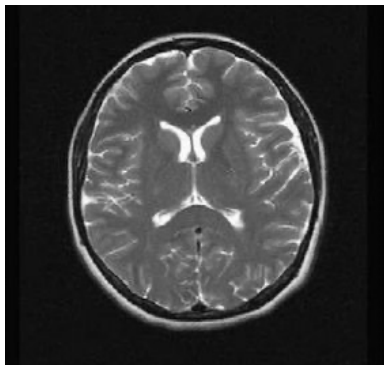
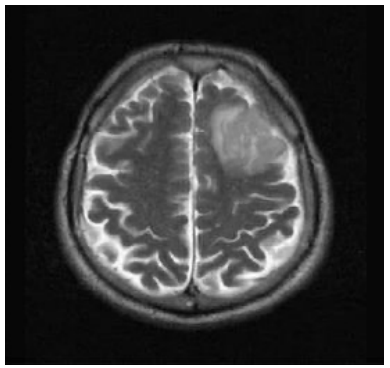
15:00-16:30		1.2 Antun/Colbrook	4.1 Langseth	5.1 Karpatne	5.2 Karpatne
16:30-18:00	2.1 Raissi				Closing Session







Is there a tumor in this image?

- Yes/no
- 23%
- 23% ± 85%
- 23% ± 5%

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Example on exp

Time	Jan 25	Jan 26	Jan 27	Jan 28	Jan 29
10:00-11:30				4.2 Langseth	
12:00-13:30	Opening Session	3.1 Strümke	3.2 Strümke		1.3 Antun/Colbrook
13:30-15:00	1.1 Antun/Colbrook	Poster 1	Poster 2	Poster 3	
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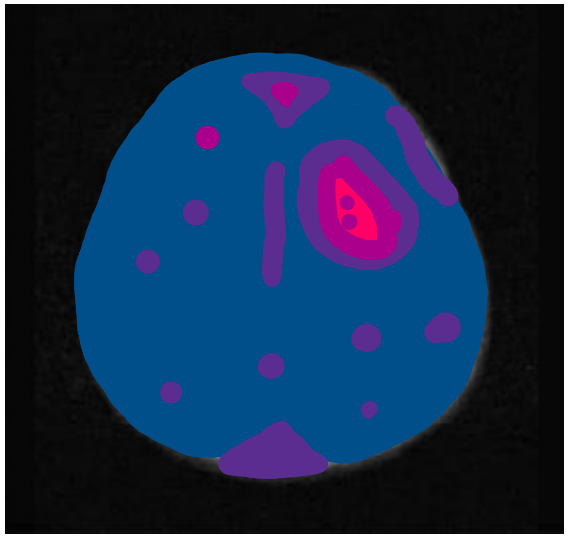
16:30-18:00	2.1 Raissi				Closing Session



- Tumor detected
- Which pixels contributed?
- How about other factors

Example on exp

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Is there a tumor in this image?

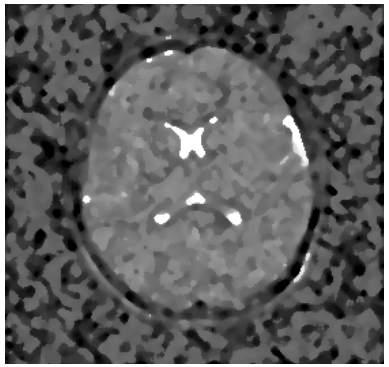
- 23% ± 85%

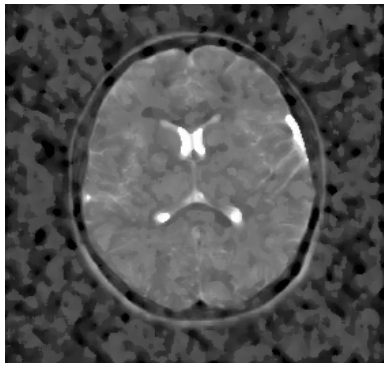
Take new image one month later

- 45% ± 63%

Tumors evolve over time

Add temporal evolution and analyse simultaneously





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Example on hyb

Time	Jan 25	Jan 26	Jan 27	Jan 28	Jan 29
10:00-11:30				4.2 Langseth	
12:00-13:30	Opening Session	3.1 Strümke	3.2 Strümke		1.3 Antun/Colbrook
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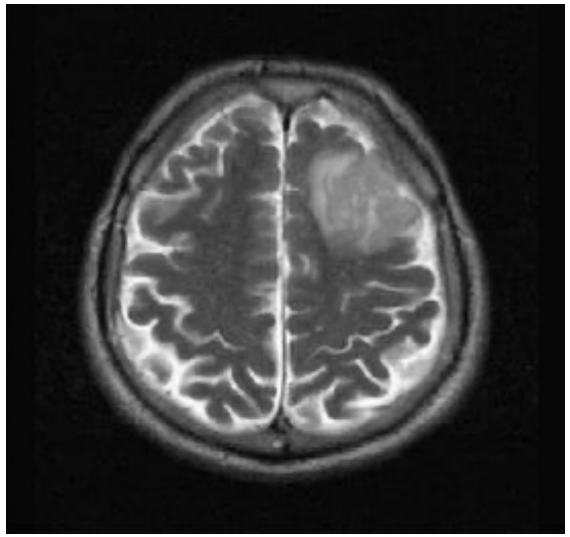
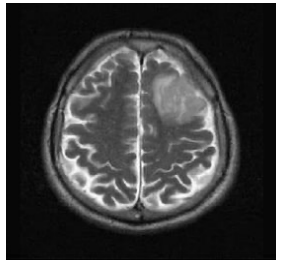
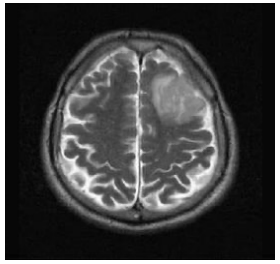
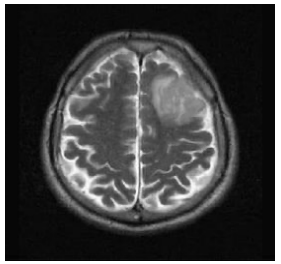
15:00-16:30		1.2 Antun/Colbrook	4.1 Langseth	5.1 Karpatne	5.2 Karpatne
16:30-18:00	2.1 Raissi				Closing Session



- Tumor detected
- Reaction to treatment can be modelled with differential equations
- Many factors – coefficients are unknown
- Use images over time to get ‘personal’ equations

$$\frac{dx}{dt} = \ldots$$

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Your work – poster sessions

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Prerequisites for the school

- Know basic machine learning terminology
- Basic python installation

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Technology for a better society