Modelling Lymphatic Cancer Progression With Hidden Markov Models

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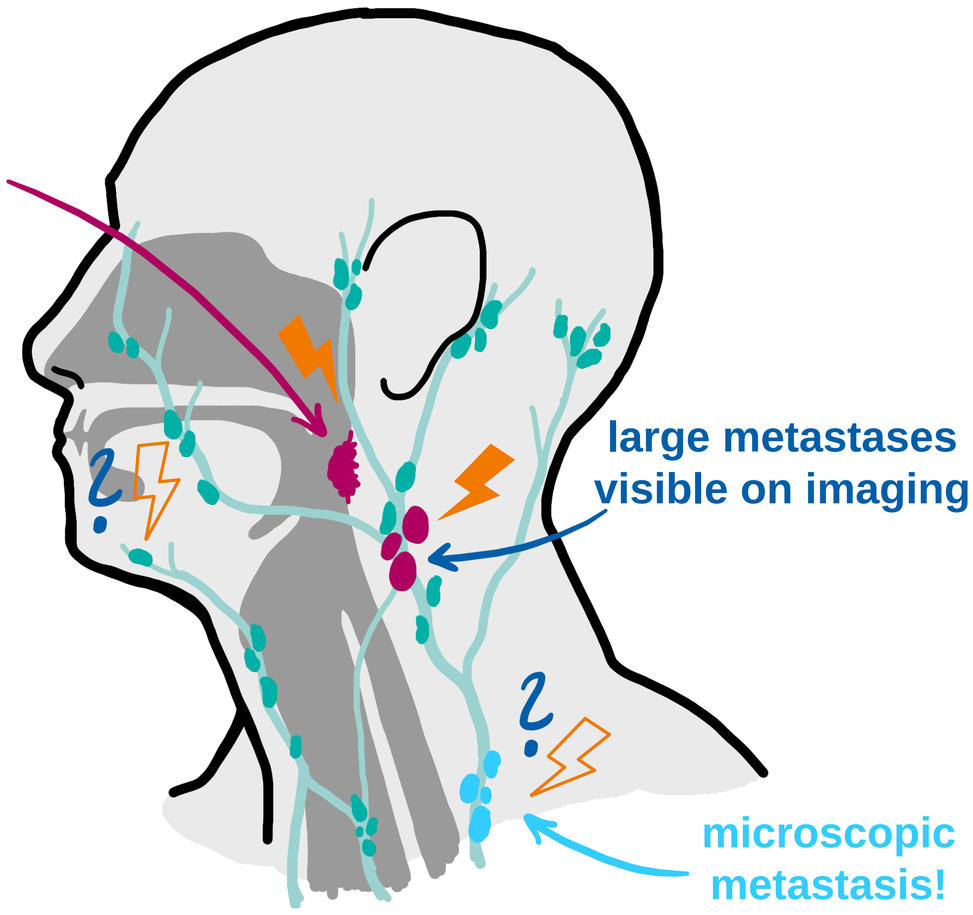
Cancer and Hidden Metastases

Cancer often spreads through the lymphatic system and forms metastases in lymph nodes. When treating patients, we aim to irradiate or resect as much cancer tissue as possible.

- MR, CT and PET scans **detect visible metastases**
- However, **microscopic metastases** are **not visible** on scans

To control the tumor, we need to treat the microscopic metastases as well!

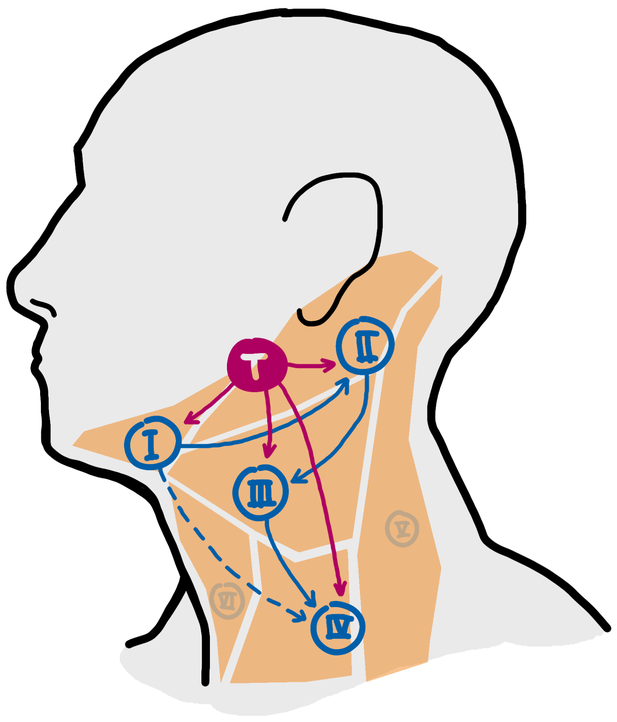
By modelling the lymphatic spread, we want to **predict the risk of microscopic involvement**. Thus, provide treatment propositions based on each diagnose.



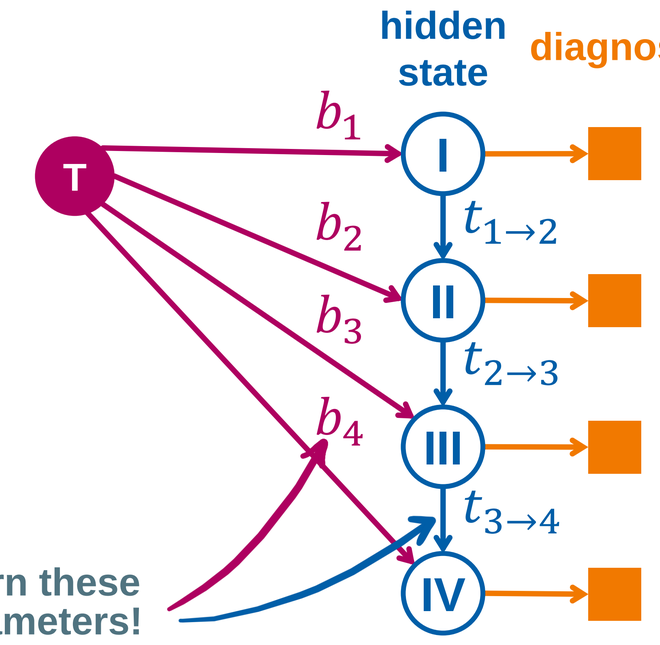
Modelling Lymphatic Spread

Knowing the underlying structure of the lymphatic network, we can produce a Graph with hidden variables to model the probability of microscopic metastases.

- The lymphatic network defines through which channels the tumor cells spread to the different lymph nodes
- An involved lymph node increases the involvement probability of a lymph node further down stream



Translate into Graph



Based on the graph we can setup a **Hidden Markov Model** which models spread over time!

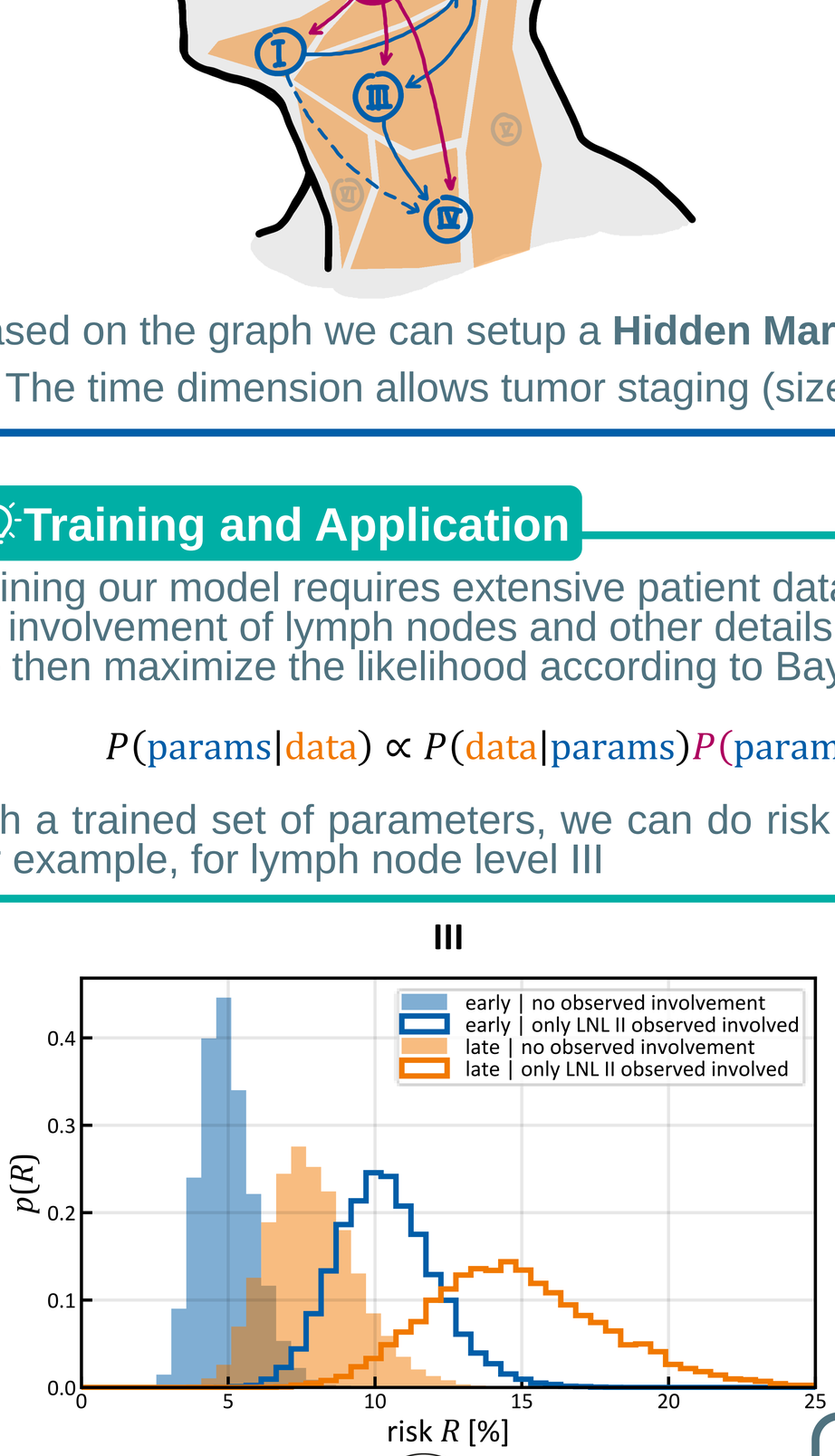
→ The time dimension allows tumor staging (size) to be included as a parameter

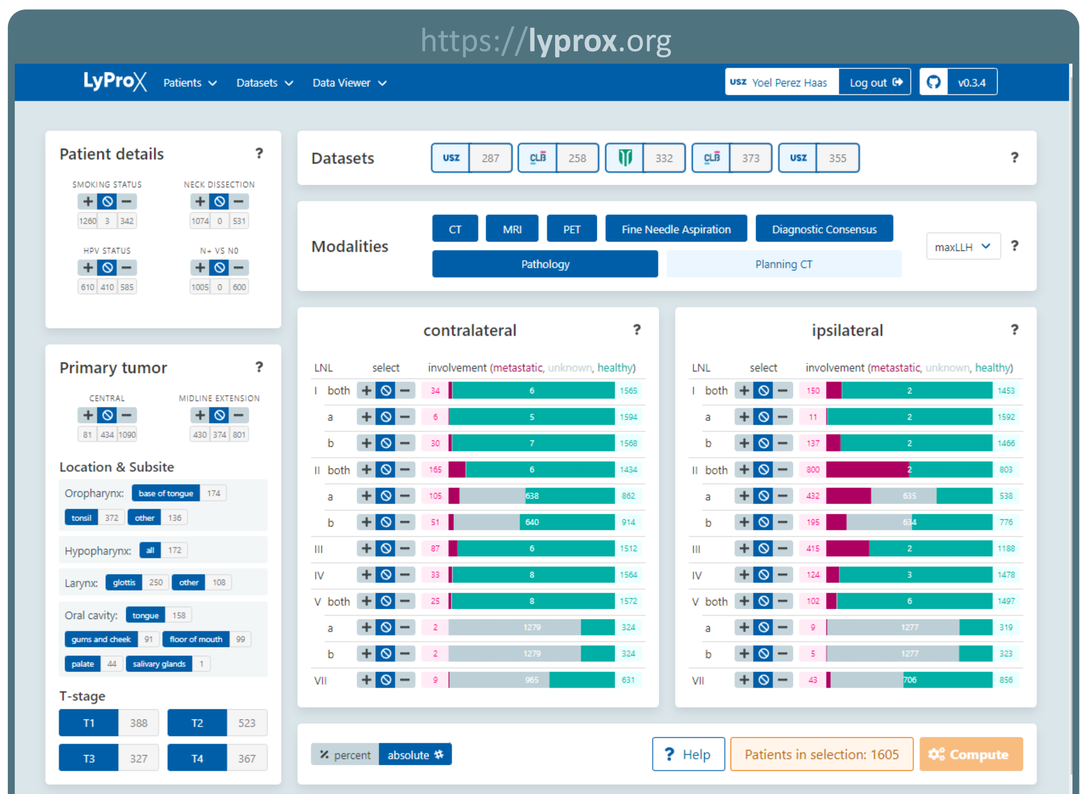
Training and Application

Training our model requires extensive patient data reporting the involvement of lymph nodes and other details.
We then maximize the likelihood according to Bayes:

$$P(\text{params}|\text{data}) \propto P(\text{data}|\text{params})P(\text{params})$$

With a trained set of parameters, we can do risk Predictions!
For example, for lymph node level III





Multicentric lymph node involvement data gathered and provided by us!

Contact Information

Interested in our work? Want to fight cancer?
Contact us!
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Or scan me for more insights!

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