Exercise class – Ex9

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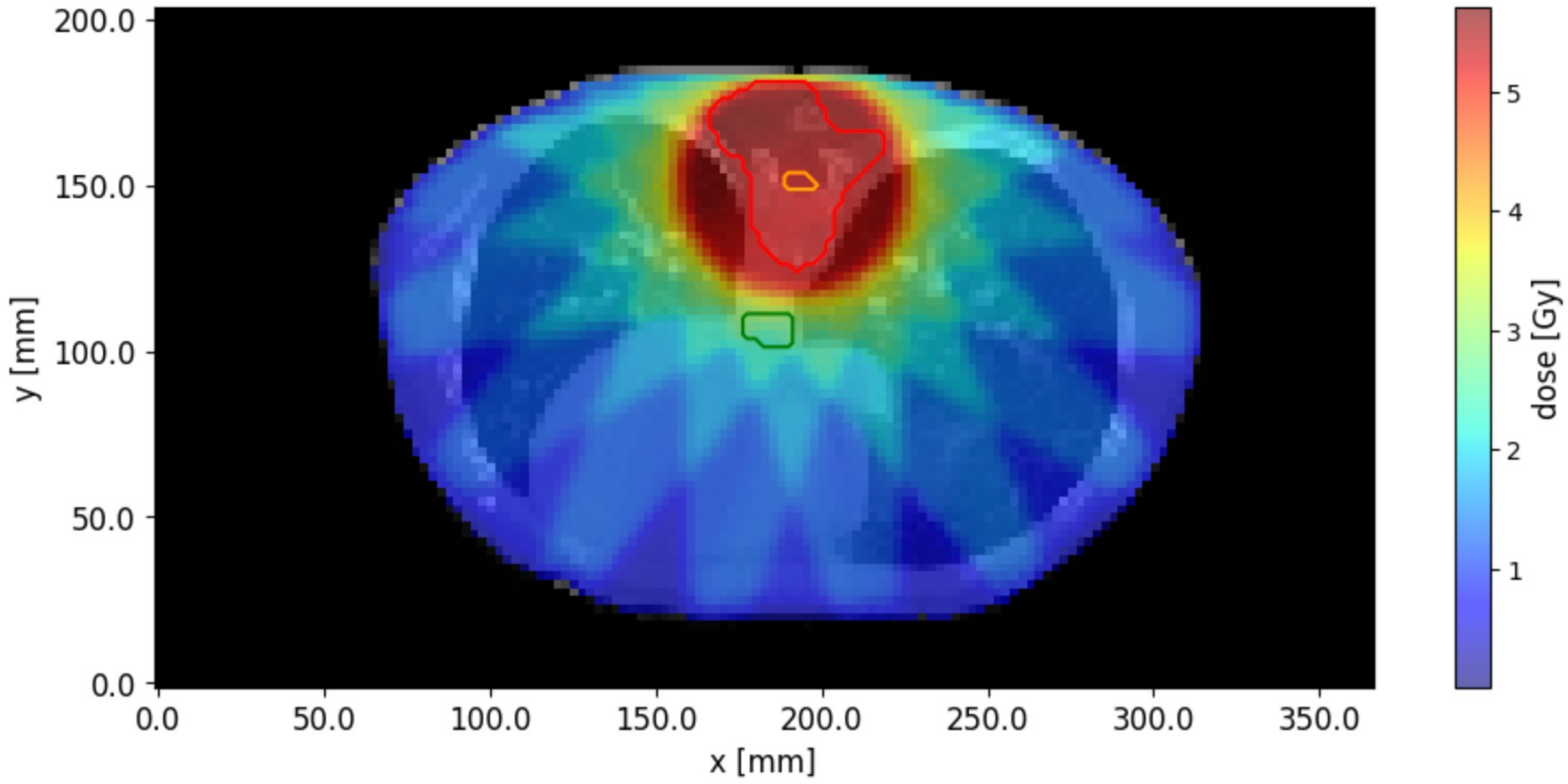
Exercise 7

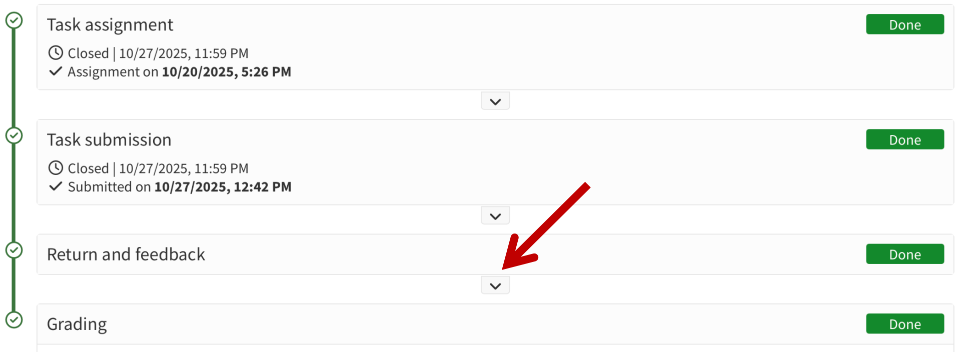
Well solved!

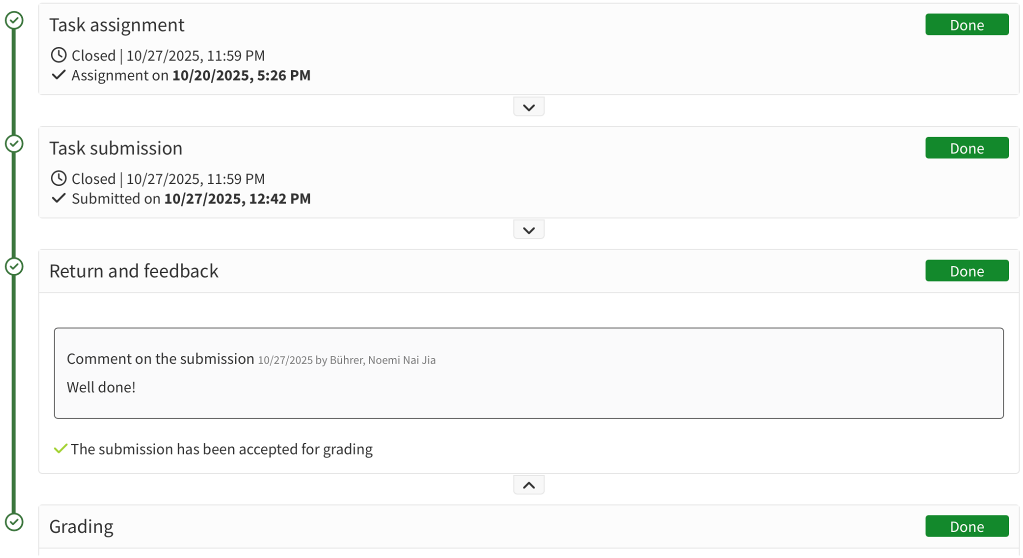


General Remarks

- Add a **colorbar** to your plot!

- Check if I left any **comments**, even though the solution was accepted.

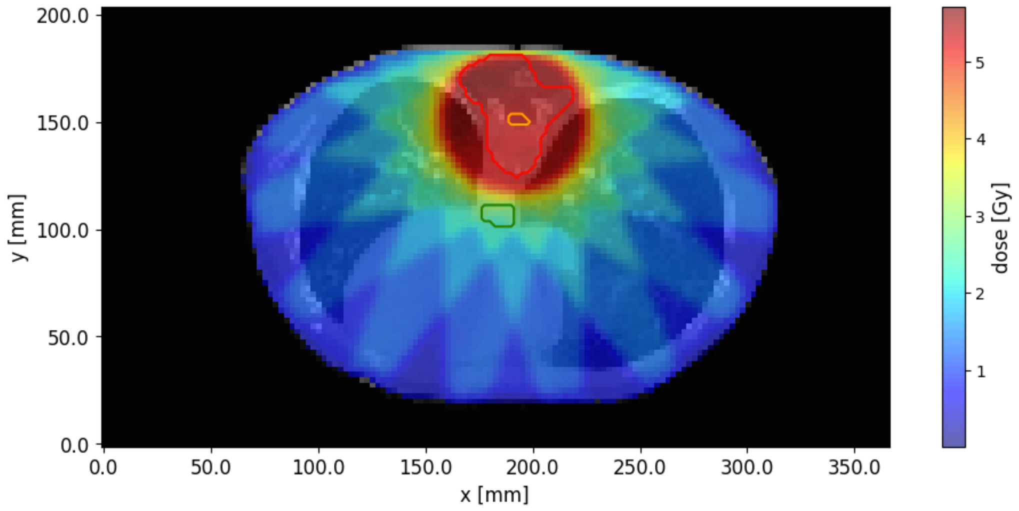




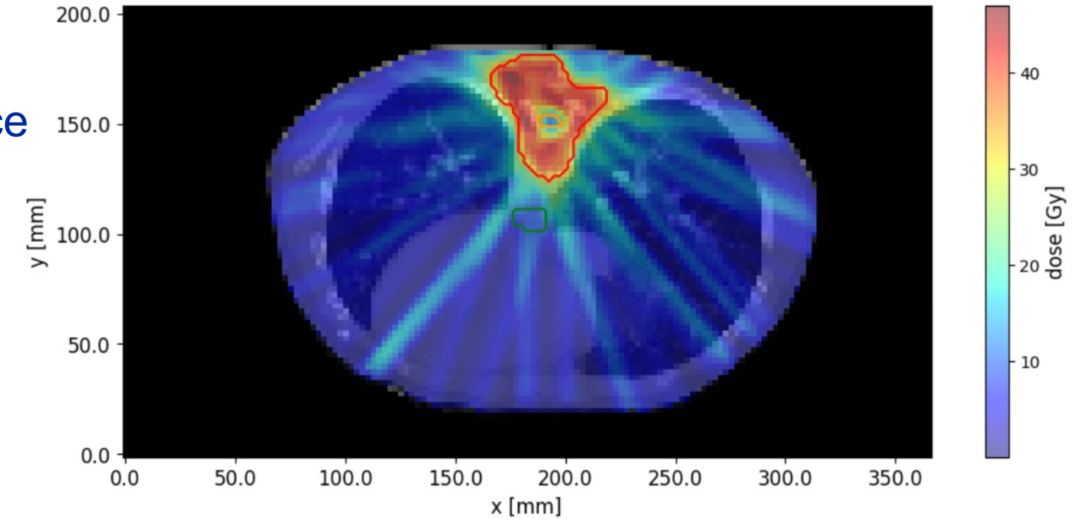
Student solution for ex. 7

Exercise 8

Implement IMRT fluence map optimization algorithm!



Optimize fluence of beamlets F_j



Any questions regarding ex.8?

Exercise 9

Implement fluence map optimization with hard constraints!

Use `scipy.optimize.minimize` to solve a treatment plan optimization problem of the form

$$\begin{aligned}
&\text{minimize} && \sum_i w_i^o \left(d_i - D_i^{max}\right)_+^2 + \sum_i w_i^u \left(D_i^{min} - d_i\right)_+^2 && (1)\\
&\text{subject to} && d_i \leq U_i^{max} && (2)\\
& && F_j \geq 0 && (3)
\end{aligned}$$

minimize(method='SLSQP')

```
minimize(fun, x0, args=(), method=None, jac=None, hess=None, hessp=None, bounds=None,
constraints=(), tol=None, callback=None, options=None)
```

Minimize a scalar function of one or more variables using Sequential Least Squares Programming (SLSQP).

Exercise 9

Hints

1. Use the SciPy documentation of `scipy.optimize.minimize` to learn how to use the function.
2. Use the method `SLSQP`, this allows you to define constraints and bounds.
2. Maximum dose constraints represent linear inequality constraints.
3. The non-negativity constraints represent bounds for the optimization variables.
4. In addition to the objective function, also provide the gradient to `scipy.optimize.minimize`. This can be done via the input parameter ‘jac’.

Exercise 9 – What we expect!