

Supplementary Table S11. List of hyperparameters for each PEFT method, with the ranges specifying the search space for hyperparameter tuning.

| Method | Hyperparameter | Range | Description |
|----------------|-----------------------|--|--|
| Adapter Tuning | num_last_layers | [1, number of Transformers in ESM-2 model] | Number of layers to add adapter modules at the end of ESM-2. |
| | learning_rate | [0.00001, 0.001] | Learning rate for Adapter and linear chain CRF. |
| Prompt Tuning | num_soft_prompt | [1, 70] | Number of soft prompts to add into the token embedding. |
| | learning_rate | [0.00001, 0.001] | Learning rate for soft prompt and linear chain CRF. |
| LoRA Tuning | r | [1,8] | Rank of decomposition matrix. |
| | α | [1,8] | Scaling const for decomposition matrix. |
| | num_last_layers | [1, number of Transformers in ESM-2 model] | Number of layers to add LoRA modules at the end of ESM-2. |
| | learning_rate | [0.00001, 0.001] | Learning rate for LoRA and linear chain CRF. |