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Prediction of results of polymerase chain reaction from oligomer and DNA sequences using recurrent neural network

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Statement of the Problem: Polymer chain reaction (PCR) is a method for detecting pathogens and genes. In PCR, short chemically synthesized DNA (oligomer) binds to DNA (template) and a "complementary" copy of the template are synthesized by DNA polymerase from the end of the oligomer-binding positions. If the two oligomers are set to bind in the opposite direction of the template at a certain distance, DNA synthesized from templates and oligomers doubles with each reaction cycle. However, the binding of the oligomer to the template may be incomplete and produce copies of the unplanned position. As a result, pathogen-detecting-PCR may produce false-positive results even on a pathogen-free sample. Since the oligomers are designed at the thermodynamically optimal position in binding to the template, there was no technology for learning the false positive results to design better oligomers. Methodology & Theoretical Orientation: I and collaborators put the relationship between the oligomer and the template into a kind of words and define a pseudo-sentence as a set of words. Next, we focused on recurrent neural networks (RNN) as supervised learning for natural sentences. We accumulated the PCR results for each combination of the oligomer and the template and trained the RNN using the pseudo-sentences and the PCR results as a teacher. The trained neural network predicted PCR results from pseudo-sentence made from oligomers and templates, just as text was predicted by distinguishing it into fiction or current affairs news. Conclusion & Significance: RNN which predicts PCR results from the base sequences of oligomers and templates has the potential to revolutionize oligomer design for PCR when the prediction accuracy is improved with a large amount of data. In addition, changes in prediction accuracy due to changes in the method of creating pseudo-sentences provide suggestions for elucidating the mechanism of PCR establishment.

Biography

Endoh dropped out of Graduate School at Hokkaido University at the age of 25 and became an Instructor at Hokkaido University in the same year (1984). He received his PhD in a research-paper review when he was 36 years old (1996). He is a Professor of Radiation Biology and a Programmer who has been self-taught since the age of 18. He has published 54 papers, but only three papers have been published using bioinformatics since 2005.

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