DERMATOLOGY PRACTICAL & CONCEPTUAL
www.derm101.com

Binary world/bivalent logic

Harald Kittler, M.D.

Citation: Kittler H. Binary world/bivalent logic [editorial]. Dermatol Pract Conc. 2012;2(2):1. http://dx.doi.org/10.5826/dpc.0202a01.

Corresponding author: Harald Kittler, MD, Department of Dermatology, Division of General Dermatology, Medical University of Vienna, Währinger Gürtel 18-20, 1090 Vienna, Austria. Tel. +43.1.40400.7700; Fax. +43.1.25330.331137. E-mail: harald.kittler@meduniwien.ac.at.

Binary world/bivalent logic

It cannot be denied that the change from analog to digital technology had an enormous effect on how we communicate in daily life. For somebody who grew up within the last 20 years it is difficult to imagine a world without cell phones, email, or online communities. The digital revolution has not only changed our daily life, it also had a significant impact on the way we share information in medicine. We can share a huge amount of data conveniently and rapidly across vast distances. Modern communication technologies eliminate distance barriers and permit the providing of health care from a distance (telemedicine). Teledermatopathology, using digital pathology images (virtual microscopy), has been successfully launched for diagnosis, education, and research. However, the digital slide scanners that are required for virtual microscopy are expensive, and transmission of large digital images requires high-speed Internet connections. Ironically persons with limited access to expert dermatopathology services will benefit the most from telemedical applications but can afford it the least. The study by Riedl et al in this issue of *Dermatology Practical and Conceptual* explores the diagnostic accuracy of interactive teledermatopathology [1]. Their method does not require that a dermatopathologist have physical "hands-on" involvement but provides real-time interactions between a technician and a dermatopathologist or between two dermatopathologists. It is an inexpensive and easy way to bring expert opinion to remote places either for education or for diagnosis (for example, to obtain a second opinion).

Apropos diagnosis

It is amazing that a binary system of only two symbols, 0 and 1, that is used by all modern computers can replace complex analog data. The binary system is based on classic bivalent logic and the classic laws of thought, including the famous "law of the excluded middle," which states that either any given proposition is true or its negation is true ("tertium non datur" or "no third possibility is given"). In the digital world it means that there is nothing between 0 and 1. A computer simply would not work if this logic principle is violated. If one applies this logic principle to semantics in general and to the language of dermatopathology in particular, it would mean that a neoplasm is either benign or malignant, it cannot be both at the same time. The statement that a lesion is a melanoma can be true or false, but it cannot be true and false at the same time. However, semantics is different from pure logic. Statements made in natural language, especially when they predict events in the future or are open to interpretation, often defy the principles of bivalent logic. Aristotle, the founder of bivalent logic, solved the problem by asserting that the principle of bivalence found its exception in propositions that predict events in the future: Either there will be metastasis or there won't, but today it is neither true nor false; but if one is true, then the other becomes false. According to Aristotle, it is impossible to say today if the proposition is correct: we must wait for the contingent realization (or not). In other words, logic realizes itself afterwards.

The complex of logical problems created by the attempt to predict future events by observing a piece of tissue under the microscope is explored in the readable essay by François Milette published in this issue of *Dermatology Practical and*

Conceptual [2]. However, we must not forget that making a diagnosis of melanoma in the absence of metastasis always includes prediction: By analogy we predict that a neoplasm with a given morphology will behave in an aggressive way. This means that even without counting mitosis or without measuring the invasion thickness we make a prognosis when we render the diagnosis of melanoma. This is problematic but unavoidable. There are different strategies to overcome this dilemma. One strategy is the application of 3-valued logic applied to vague or undetermined cases. In our example of melanoma it means that there are 3 categories: melanoma, nevus, and " I do not know." Most of you will know that this was the strategy favored by Bernie Ackerman. Another strategy is to apply a sort of "fuzzy logic" that allows for categories that are not well defined and open to interpretation. Fuzzy logic is a form of many-valued logic; it is approximate rather than exact and may have truth values ranging between 0 and 1. In semantics fuzzy logic is often introduced by fuzzy terms such as "atypical Spitz tumor" or "melanocytic tumor of uncertain malignant potential" (MELTUMP). These terms are fuzzy purposely and have been established to prevent that a diagnosis is completely false. Finally there is a third possibility to overcome the dilemma of uncertainty when predicting future events: to defy logic! The proponents of this solution apply terms like "metastatic Spitz nevus" or "malignant blue nevus" defying the basic principle of logic that if one statement is true, then the other becomes false.

Everyone has to choose his own way of dealing with the dilemma of uncertainty and the choice will in part depend on your character. I am more inclined to choose solution 1 (which in part is idealistic and platonic) but I can understand the practical reasons of applying fuzzy logic (solution 2) to our problem, although I am convinced that this cannot be a final solution and one should try everything to remove the "fuzziness." However, as a rational person I cannot choose an irrational solution like solution 3.

Reference

1. Riedl E, Asgari M, Alvarez D, Margaritescu I, Gottlieb GJ. A study assessing the feasibility and diagnostic accuracy of real-time teledermatopathology. Dermatol Pract Conc. 2012;2(2):2. http://dx.doi.org/10.5826/dpc.0202a02.
2. Milette F. Predicting outcome: a fourfold delusion! Dermatol Pract Conc. 2012;2(2):14. http://dx.doi.org/10.5826/dpc.0202a14.