Preface

Slime mould *Physarum polycephalum* is a large single cell capable for distributed sensing, concurrent information processing, parallel computation and decentralized actuation. The ease of culturing and experimenting with Physarum makes this slime mould an ideal substrate for real-world implementations of unconventional sensing and computing devices. The book is a treatise of theoretical and experimental laboratory studies on sensing and computing properties of slime mould, and on development of mathematical and logical theories of Physarum behaviour. We show how to make logical gates and circuits, electronic devices (memristors, diodes, transistors, wires and chemical and tactile sensors) with the slime mould. We demonstrate how to modify properties of Physarum computing circuits with functional nanoparticles and polymers, to interface the slime mould with field-programmable arrays, and to use Physarum as a controller of microbial fuel cells. Physarum solves spatial problems by developing an optimal network of protoplasmic tubes. We use this feature of the slime mould to imitate road networks and mass migration, historical developments and future space explorations. A unique multi-agent model of slime is shown to serve well as a software slime mould capable for solving problems of computational geometry and graph optimization. The multi-agent model is complemented by cellular automata models with parallel accelerations. Mathematical models inspired by Physarum include non-quantum implementation of Shor's factorization, structural learning and computation of shortest path tree on dynamic graphs, supply chain network design, p-adic computing and syllogistic reasoning. Spatio-temporal behaviour of the slime mould has also manifested in musical composition, artistic interacting performances, translating Physarum responses to environmental stimuli to emotions of an android robot and mechanics of creativity. The book is a unique composition of vibrant and lavishly illustrated essays which will inspire scientists, engineers and artists to exploit natural phenomena in designs of future and emergent computing and sensing devices.

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