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# iGEM : Input-Output Yeast Diploids

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## 1 Introduction

Synthetic Biology is a novel and a prospective field of science, where biologists and engineers join forces to pursue goals previously thought unachievable. The idea is to use knowledge of current living organisms and genetic engineering methods to create completely new organisms, that could accomplish tasks previously unimaginable. The International Genetically Engineered Machine competition (iGEM) is a world-class competition in Synthetic Biology aimed at undergraduate student teams from all over the world. Given a kit of biological parts, each team has to design a novel systém and improve the current parts.

Our iGEM team is a student-run undergraduate multidisciplinary team sponsored by the Georgiev lab, Faculty of Applied Sciences at UWB, and joined by students from Faculty of Medicine and Faculty of Science, Charles University. We represent the first Czech team, but we believe with our highly experienced supervisors, we can establish the university in the iGEM competition.

The team is composed of six undergraduate students and several advisors across several disciplines (Control Engineering, Molecular Biology, Electronic engineering, Medicine). Using expertise and knowledge from all three fields of study we will create a project incorporating design elements from these disciplines to speed up the bioengineering process.

The iGEM competition attracts highly involved and passionate students and grants them the opportunity to experience a diverse and cooperative working environment where they can develop their practical skills and pursue their goals. Our recent human practices have allowed the team to share and collaborate with fellow iGEM teams around the world in finding solutions to their own design dilemmas. Hence there is a networking aspect to the competition, through which stronger ties between students and experts are developed.

## 2 Our Project

While many great things have been created using synthetic biology, we are slowly approaching a limit to what we can do. Working genetically engineered machines can usually only be constructed from less than 6 modifies genes. After that point, the natural nonlinearity of biological systems takes over, and the machine doesn’t work. The nonlinearity is also problematic because the systems are not modular, i.e., adding another part to a synthetic pathway may completely change the behavior of other parts.

In our project, we would like to change this precedent. We would like to synthetically create a set of different input-output yeast diploids (so called IODs), each with a different genetical program . Each of these diloids would be completely autonomous, and its behavior would be defined by a set of input-output rules. Diploids would communicate amongst themeselves and their surrounding to weave a complex communication web. Because each diploid would be autonomous there would be no problem to make the system as modular as neccessary.

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Apart from working on the actual system we are trying to come up with ideas on where to use IODs. It is clear that a modular way of building genetically engineered machines would be useful in many different areas of science and industry. Implications in medicine would also be plentiful. So far ideas have been proposed to use IODs as a quick and easy way to detect diseases from blood and to use IODs as means of collecting toxins or valuable chemicals from solutions. Another possibility is to use IODs to build complex shapes on a microscopic level (see Figure 1).

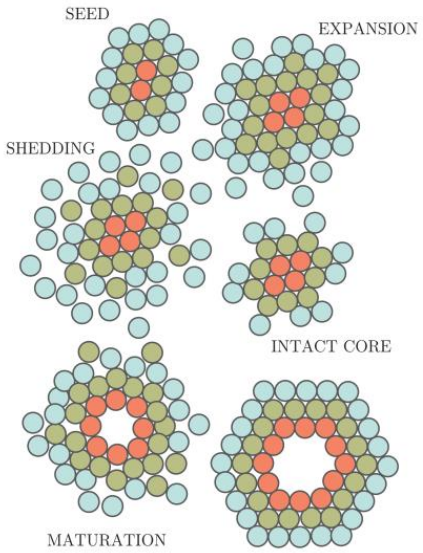


**Figure 1:** IODs forming complex shapes

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