The Future of Open Source:
From Drug Discovery to Synthetic Biology

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Introduction

Why Open Source Matters

The “Open Source Biology” Idea

- Analogy, Rhetoric, Reality
- Synaptic Leap: How Big is the Landscape?

A Rational Design Approach

1. Background
    - Definitions
    - Showstoppers
    - OS Theory: Incentives & Social Welfare
    - The Drug Discovery Landscape
2. Candidates
3. Synthetic Biology
4. A (Quick) Word About Licenses
5. Synaptic Leap - A Short Infomercial

1.Background: Definitions

Definition:

Goal-Oriented Collaboration

+

Donated Labor & Materials

1.Background: Showstoppers

The Usual Suspects:

- Developing Drugs is Costly
  - Drug Discovery is a *Pipeline*
- Competition With Patent Incentives
  - A Neglected Disease Niche?
  - Companies Might *Fund* Open Source

1.Background: OS Theory

Incentives

- Ideology
- Education and Signaling
- Own-Use
  - For Hobbies
  - For Work
  - For Employer
- Complementary Goods & Services
- Standards Wars

1.Background: OS Theory

Social Welfare

Advantages

(Donated Labor)

Price of Information

Agency Problems/Transparency

Disadvantages

Inadequate Incentives?

1.Background:
The Drug Discovery Landscape

Basic Research
Finding Targets
Optimizing Targets
Finding Lead Compounds
Optimizing Lead Compounds
Process Development
Pre-Clinical Testing
Phase I Tests
Phase II Tests
Phase III Tests
Approval
Manufacturing
Phase IV Tests
Marketing & Distribution

2. Candidates

Basic Research } Open Science
Finding Targets
Optimizing Targets
Finding Lead Compounds
Optimizing Lead Compounds
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Phase I Tests
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2. Candidates: Open Science

- Examples
  - BioPERL
  - HGP, SNP Consortium, HapMap, AfCS.
- Traditional Academic Incentives
  - Education, Signaling, Own-Use, Ideology.
- Showstoppers?
  - Physics Precedents
    - Big Science (*cf.* FermiLab)
    - Virtual Experiments (PDG, TOI)
- Definitional Objection - Is It Open Source?
  - HapMap License

2. Candidates

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} *In Silico* Biology

2. Candidates: *In Silico* Biology

Social Analogy

- Biologists ~ Computer Scientists
- Incentives ~ Education, Signaling & Ideology
- A *Social* Experiment

Science Analogy

- Doing Science With Databases
- *In silico* biology ~ software debugging
- A *Scientific* Experiment

2. Candidates: *In Silico* Biology

Social Welfare

- Donated Labor
- Lower R&D Costs
  - The SNP Consortium Problem
- Lower Manufacturing Costs
- Transparency

2. Candidates: *In Silico* Biology

Example: Tropical Disease Initiative

Mechanics

- On-Line Forums & Running Estimates
- Philosopher Kings?
- Bridging Institutions

2. Candidates: *In Silico* Biology

Showstoppers

- Competition With Patents
- Are *in silico* methods good enough?

Would it Work for Rich Nation Diseases?

2. Candidates

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} "Wet" Chemistry & Biology

2. Candidates: Wet Chemistry & Biology

The Reagents Problem

Big Science Grants

"Scrounging Strategies"

- TDI, Benkler

Low Cost, High Ingenuity Problems

- Mat Todd/Schistosomiasis Project

What are the Limits?

2. Candidates

Basic Research
Finding Targets
Optimizing Targets
Finding Lead Compounds
Optimizing Lead Compounds
Process Development
Pre-Clinical Testing
Phase I Tests
Phase II Tests
Phase III Tests
Approval
Manufacturing
Phase IV Tests } Off Label Testing
Marketing & Distribution

2. Candidates: Off-Label Testing

Examples

- von Hippel Proposal

Incentives

- Ideology, Education & Signaling
- Costs are Already Paid For
- Competition With Patents?

Social Welfare

- Transparency

2. Candidates

Basic Research
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Phase III Tests
} Clinical Testing
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Manufacturing
Phase IV Tests
Marketing & Distribution

2. Candidates: Clinical Testing

Examples

- (None)

Incentives

- Ideology, Education, Signaling,
- Complementary Goods
  - Patents Would *Support* OS

Advantages

- Transparency

3. Synthetic Biology

From Garage Science to Standard Parts
Reading Tea Leaves
A Chance to Intervene

Incentives: Five Stories
Ideology, Education and Signaling, Own-Use, Complementary Goods & Standards Wars

3. Synthetic Biology: Incentives

Story 1: Ideology, Education, Signaling, Own-Use

Story 2: Shared Costs

Analogy: "Operating Systems *vs.* Applications Programs"

3. Synthetic Biology: Incentives

Story 3: Shared Benefits

Analogy: Game Theory & Embedded Linux

Multiple Possible Equilibria

Prodding the System

Story 4: Appropriability May Not Be Valuable

Analogy: Software Modules & LINUX

3. Synthetic Biology: Incentives

Standards Wars?

- **Parts Repository – Strong Tipping Effects**
- **Private vs. Public Repositories**
- **An Unpredictable Process**

3. Synthetic Biology: Social Welfare

Open Standards, Competition, Antitrust National Security?

4. License

"Copyright *vs.* Patents"

The Licensing Fetish

What's Wrong With the Public Domain?

- The Consumer Sovereignty Argument
- The Capturing Argument
- The Stability Argument

4. Licenses

- GPL'ing Molecules
  - Patents *vs.* Copyright
    - Filing & Enforcement Costs
    - Licensing & Waiver Law Issues
    - Patent Misuse?
  - Patents & Neglected Diseases
- Embargos
- Legal Holding Entities
- Patent Pools
  - BIOS/Bioforge

5. Infomercial

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