DIGITALPHILOSOPHY | **коммент** kiwi0fruit (**480**) | | | | **настройки** | выйти

1

Open-ended natural selection of interacting code-data-dual algorithms as a property analogous to Turing completeness [this time no redundant info] (self.DigitalPhilosophy)

отправлено 22 ч назад, изменено * автор kiwi0fruit

The goal of this article is to promote an unsolved mathematical modelling problem (not a math problem or question). And unlike math questions it still doesn't have a formal definition. But I still find it clear enough and quite interesting. I came to this modelling problem from a philosophy direction but the problem is interesting in itself.

Preamble

The notion of Turing completeness is a formalization of computability and algorithms (that previously were performed by humans and DNA). There are different formalizations (incl. Turing machine, μ-recursive functions and λ-calculus) but they all share the Turing completeness property and can perform equivalent algorithms. Thus they form an equivalence class.

The open-ended evolution is a not very popular research program which goal is to build an artificial life model with natural selection which evolution doesn't stop on some level of complexity but can progress further (ultimately to the intelligent agents after some enormous simulation time). I'm not aware of the state of the progress of open-endedness criteria formulation but I'm almost sure that it's still doesn't exist: as it's either connected to results of a successful simulation or to actually understanding and confirming what is required for open-endedness (I haven't heard of either).

The modelling problem

Новая ссылка

Новая текстовая

DigitalPhilosophy

покинуть   106 читателей

10 пользователей находятся здесь

you are a moderator of this subreddit. (изменить)

you are an approved user on this subreddit. (покинуть)

☑ Показать мой флейр в этом сабреддите. Он выглядит так:

kiwi0fruit (редактировать)

Digital philosophy is a direction in philosophy/metaphysics that relies on computer science and theory of computation. It commonly assumes discrete and finite/countable ontology.

Posts about digital philosophy together with posts close in spirit (or logically connected) are welcome in this subreddit. For example the welcomed posts may be about:

- digital physics,
- digital probabilistic physics,
- artificial life,
- open-ended evolution,
- universal Darwinism in physics,
- philosophy of artificial intelligence.

Original definition of the digital philosophy (DP) by Edward Fredkin was rather specific but for example Gregory Chaitin's ideas are indeterministic instead of deterministic but they are still considered

Just as algorithms performed by humans were formalized and property of Turing completeness was defined: the same formalization presumably can be done to the open-ended evolution observed in nature. It went from precellular organisms to unicellular organisms and finally to Homo sapiens driven by natural selection postulates (reproduction-doubling, heredity, variation-random, selection-death, individuals-and-environment/individuals-are-environment) and the Red Queen hypothesis that resulted in increasing complexity. Open-endedness property here is analogous to Turing completeness property. It could be formalized differently but it still would form an equivalence class.

And the concise formulation of this process would be something like **Open-ended natural selection of interacting code-data-dual algorithms**.

Code-data duality is needed for algorithms being able to modify each other or even themselves. I can guess that open-endedness may incorporate some weaker "future potency" form of Turing completeness (if to assume discrete ontology with finite space and countable-infinite time then algorithms can became arbitrary complex and access infinite memory only in infinity time limit).

Please consider if it's an interesting mathematical modelling problem for research and share your thoughts.

Further info links

- open-ended evolution subreddit
- article on my (futile) efforts and it's old Reddit discussion
- predecessor of this promotion article
- digital philosophy subreddit (posts by kiwi0fruit)

---

belonging to DP. So it's more an umbrella term now.

According to Wikipedia DP is advocated by certain mathematicians and theoretical physicists, including: Edward Fredkin, Konrad Zuse, Stephen Wolfram, Rudy Rucker, Gregory Chaitin, and Seth Lloyd.

Recommended subreddits:

- r/compsci Computer Science: Theory and Application
- r/algorithms Computer Science for Computer Scientists
- r/oee Open-Ended Evolution
- r/alife Artificial life

16 комментариев редактировать

поделиться сохранить скрыть выделить

удаление спам удалить одобрить

закрыть nsfw crosspost

все комментарии (16)

сортировка: **новое**

  установить как предложенную сортировку

  запретить ответы во входящие (?)

включить режим соревнования make announcement

pin to profile

[save]   контентная политика помощь в форматировании те

◄ |▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬| ►

Подсветить комментарии, добавленные с предыдущего визита:

| 28 мин назад ▼ |

[−] **kiwi0fruit** [S] 1 очко 24 мин назад

> I'm not aware of the state of the progress of open-endedness criteria formulation but I'm almost sure that it's still doesn't exist: as it's either connected to results of a successful simulation or to actually understanding and confirming what is required for open-endedness (I haven't heard of either).

Well, here is a paper about this: https://thewinnower.com/papers/2309-what-s-holding-artificial-life-back-from-open-ended-evolution

I can compare it with Biogenesis (and my Color Mod specifically)...

"The population stops changing at all after a certain point:"

Biogenesis populations always change. But you might set the "C4" color function to 0 (probability), if you (anyone) want to test this in very long simulations (free download, if people want to play with it). C4 can make all other plant functions/colors useless, if it starts to dominate. Already reworked C4, but the new version isn´t uploaded yet.

"Novel organisms stop appearing in the population:"

Well, what is a novel organism? Sure, if I do not program new stuff, I will finally have seen nearly all evolutionary viable body plans. But it doesn´t really get stuck here?

"Organismal complexity stops increasing:"

Well, I could change some values, so that the organisms will add more and more genes. But they would only add more and more photosynthetic segments (not interesting complexity). I actually made less complex (photosynthesis) organisms more viable in the Color Mod to increase ecosytem complexity.

"Ecosystem diversity stagnates:"

I really don´t know, if this is true, or not. Biogenesis ecosystems have a maximal biomass (amount of CO_2, to not slow down the simulation). Ecosystems cannot get more and more complex, if we cannot simulate them with more individuals. If someone wants to really test this he would need to simulate with many networked worlds. The ecosystems become more and more complex, when I add CO_2, thus far it does not stop...

"Shifts in individuality are impossible."

Yes, this is hardcoded. I added altrustic functions in the Color Mod, but there is nothing multicellular to see here.

And intelligence:

Real intelligence (in any way) isn´t possible in Biogenesis of course, but natural selection can make them react in a sensible way to predefined sensoric input (only in my Color Mod). The behaviour of evolved organisms actually does make sense at least. They cannot really go further however, even if we would run it forever. There is no neural net anyway, or something like that.

Biogenesis organisms also cannot evolve new functions (or colors). They need to use the existing 44 colors/functions in the Color Mod (they are like elements of the periodic table in some way, foundation elements of a biogenesis world). The Biogenesis world is just less complex than the real world.

It might be possible, that evolution is "open ended" in Biogenesis, but the world just isn´t as complex (totally not) as the real world. Therefore it doesn´t mean that much. People could run a huge networked Biogenesis Color Mod world and try to falsify, that evolution already did its best by creating human made organisms themselves. But even if human made organisms don´t do better (I do not really know, did not test this that much), than the ones created by evolution, they (both of course) cannot break the limits of the world they live in. Insofar, the program itself is just not "open ended" enough...

([MarcoDBAA@reddit](#))

> [−] **kiwi0fruit** [S] 1 очко 24 мин назад
>
> Nice short article. It has a right idea of analyzing obstacles as open-endedness now is abstracted as negation: lack of being stuck.
>

[−] **kiwi0fruit** [S] 1 очко 34 мин назад

Hypothesis: you don't know how to formulate a mathematical question.

Seriously? What do you want us to answer? Evolution is Turing complete?

At first you have to define what you are considering: try to formalize the problem. What are your states? What maps to what?

([LittleByBlue@reddit](#))

> [−] **kiwi0fruit** [S] 1 очко 30 мин назад

If I'd knew how to formulate this as a precise mathematical question I guess it would be half (or even more!) of the problem solved.

> [−] **kiwi0fruit** [S] 1 очко 30 мин назад
>
> So I guess you will have to study some math.
>
> I want to suggest Analysis 1-3, Linear Algebra 1-2, Algebra 1, Probability Theory 1. And while you are at it Theoretical Physics 1: classical mechanics.
>
> (LittleByBlue@reddit)
>
>
> > [−] **kiwi0fruit** [S] 1 очко 29 мин назад
> >
> > I think you misunderstood. I meant that I don't know how to formulate precisely open-endedness in the model. I guessed that it's essential for the model to exibit open-ended behaviour. But seems that there is actually another way (see this comment). Who knows - may be open-endedness might be achieved in the model even without formulating it precisely. And that might be the right way as open-endedness is abstracted now as negation: lack of stopping of complexity increase. So analyzing what prevended the model from previous iteration from progressing further would be actually formalizing open-endedness.
> >
> >

[−] **kiwi0fruit** [S] 1 очко 33 мин назад

It's not a mathematical question (as it was stated at the beginning of the post).

And I'm not that optimistic to expect you to answer any questions...

The goal was to communicate this modelling problem and luckily to interest someone.

And it's both a modelling problem and a formalizing problem. And there are too few mandatory restrictions placed by reality (all of them abstract and not formalised): notion of open-endedness and postulates of natural selection.

And I listed 1) unformalised notion of algorithm, formalized notions of 2) computability (given by Turing machine and others) and 3) Turing completeness as counterparts for what I'm curious.

In case of the task of formalizing notion of algorithm we have clear states that we can map.

When talking about open-endedness it is not the case unfortunately... Natural selection postulates can applied to parts of the model but open-endedness is a property of a model as a whole. And in my opinion it's a holistic problem that cannot be reduced to parts. But there might be another formulation that captures the same but is more precise. Or I'm wrong and it still can be split. But how?...

> [−] **kiwi0fruit** [S] 1 очко 31 мин назад
>
> Or I'm wrong and it still can be split. But how?...

It is quite simple: create a mathematical model. Then study that model. This is what every mathematician does. Literally all the time.

For instance set `W = (M=(0, ..., n), f)` where n is an integer and f a map from N to N. Now you want to introduce some kind of order. One option might be: use a smooth function g from R to R and check if `for a_i in M g(a_i) = a_{i+1}`.

Then try to find a way to derive a map f' from f and M. Now set `W_0 = W` and `W_{i+1} = (f(M_i), f')`.

What properties does W_i have? What happens for i goes to infinity? How does the order change over time? Are there clusters with higher order?

Then you can think about what that all means. And what effects do starting conditions have? Are there attractors to which the systems tend to evolve?

Once you have answered these questions you can think about what all this means for our world.

Edit: probably is choosing f from N^n to N^n more useful. Also N are nonnegative integers and R are the real numbers.

(LittleByBlue@reddit)

> [−] **kiwi0fruit** [S] 1 очко 31 мин назад
>
> Essentially you are suggesting defining a model then analyzing it - which is what math about. In our case the main criteria of open-endedness can't be formalized - but let's assume that we can analyze if it's in the model or not. So the workflow is: 1) to create some **random** starting model with natural selection 2) analyze it's behaviour (that would be a hard part) 3) create new model incorporating insightes about previous random model 4) repeat n times.
>
> *And there won't be shortcuts and insights until some large number of not working models were studied.*
>
> Sounds reasonable. Thanks.
>
> UPD: I guess there can still be some shortcuts via intuitions but they are not likely to appear before analyzing the first random model (but they are still possible to appear).
>

[−] **kiwi0fruit** [S] 1 очко 17 ч назад

> If it doesn't have a formal definition it's not a mathematical question. The lack of formalism is part of why we can't figure out what you're talking about in these articles.

(jmite@reddit)

[−] **kiwi0fruit** [S] 1 очко 17 ч назад

If it would make things clearer: I'm curious about a model of endless self-organizing novelty creation that comes from combining natural selection and some simple algorithms formalization.

...

But I guess this comment is like an anecdote (not much clearer):

> Magician: Put the egg under the hat, do the magic passes ... Remove the hat and ... get the same egg but in the side view ...

[−] **kiwi0fruit** [S] 1 очко 17 ч назад

Thanks. I agree that this should not be called a mathematical question. What a task of formalizing of some natural phenomenon called? Science? :) A mathematical modelling task may be?

I've met surprisingly many people that can figure out what's this about (see comments here). If you cannot figure out what I'm curious about then you are for sure not a person able to formalize and solve this problem. Quoting one comment:

> It's interesting how people can still understand what you're talking about.

UPD: I'll call it mathematical modelling problem for now (not a math problem or question).

[−] **kiwi0fruit** [S] 1 очко 17 ч назад

Hey, just wanted to drop in and tell you that I appreciate your post, and the fact that you are constantly editing it without anyone responding to it😬. I'm currently pretty occupied with some other stuff, but I plan on continuing to work on my own alife simulation very soon again.

Regarding your post, I haven't looked much into the question of open-endedness at all, but formulating some well-defined benchmark/test would surely help everyone. I just think it will be a long time (if ever) until we actually reach open-ended evolution, just because it requires a very complex environment with theoretically endless niches that are somehow procedurally generated.

The concept of arms races/red queen sure is important, but the environment also needs to change for interesting stuff to happen. You talk about this as well – individuals are the environment. But again, I didn't look much into it, just wanted to say I appreciate your research.

(redsharktooth@reddit)

[−] **kiwi0fruit** [S] 1 очко 17 ч назад

Thanks for your feedback :) I rewrote the article because I noticed a way to look at it in a more appealing way for math and computer science communities. So I could post it to more subreddits :)

But it's actually a better point of view in my opinion overall.

[−] **kiwi0fruit** [S] 1 очко 17 ч назад

It seems the laws of physics can be carried out by a Turing Machine. Hence, the claim of openedness appears (to me) to be that you can define a Turing Machine with a finite set of rules, yet it can achieve arbitrary levels of complexity. You haven't defined complexity, but if you took something like Kolmogorov complexity, then that's clearly not possible.

([The_Serious_Account@reddit](#))

[−] **kiwi0fruit** [S] 1 очко 17 ч назад

Not exaclty. But if you take a Turing machine that can modify **itself** using **random** coin tosses (modify itself countably infinite times, and, maybe, extend the tape) then it would look more like what I'm interested in.

But I guess it's still not **that** exactly as there are too many things I'm usure about.

π