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On Measurable Tournaments for Progressing Generalized Cognizers4

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Abstract

Researchers such as Kurzweil and Goertzel predict that AI, due to the progress in LLM is entering a period of exponential growth toward Artificial General Intelligence (AGI). They believe that if such AGI is capable of rewriting its own code, it could evolve into a superhuman AI, possessing the cognitive and computational power of all human civilization

We interpret this requirement for AGI as an unavoidable ability of generalized cognizers to generate expectably reasonable versions of development of themselves, along with trustworthy means of measuring these versions and selecting the most promising of them wrt the utilities of cognizers.

Generalizing our prior assertion that knowledge-based chess strategies can be strongly scaled by local tournaments, we argue an analogous statement for suitable measuring of the progress of generalized cognizers in the frame of an adequate theory of cognizing and address to the ways to strengthen it.
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1. Introduction

1.1. Significant progress in machine cognizing, thus in its kernel ability to learn, is challenging to empower and accelerate the learning of generalized cognizers.
1.1.1. Futurologists such as Kurzweil [1] and Goertzel[2] interpret these aims as an invention of Artificial General Intelligence (AGI).

Gertzel is certain that AI research is entering a period of exponential growth, arguing it by referring to Kurzweils prognostications, due the progress of LLM and the ongoing combination of paradigms of AI into a single framework of AGI.

He believes that if such AGI could rewrite its own code, it could evolve into a superhuman AI, possessing the cognitive and computational power of all human civilization.

1.2. We interpret the requirement to AGI to rewrite its own code as an unavoidable ability of mighty generalized cognizers to generate expectably reasonable versions of their development, along with trustworthy means of measuring these versions and selection of the most promising of them wrt the utilities of cognizers.

1.3. In fact, such an interpretation reduces the problem of mighty cognizers to the elaboration of effective evolutionary algorithms exempted from their main prohibiting difficulties in providing suitable fitness and selection constituents [3].

1.3.1. These difficulties were relieved for a particular class of problems approximated by chess-like reproducible games (rg). It was argued that the corresponding knowledge-based rg strategies can be, in fact, strongly scaled by local tournaments wrt ideal tournaments of all possible strategies of those problems [4, 5, 6, 7].

1.3.2. The corresponding theorems have been proven [4] stating that in classes A of algorithms enabling **to enumerate** all possible appearances of algorithms by enumerating the states of regulators determining any of their appearances, it is possible to arrange the sequences of local tournaments between those algorithms similar to those by Elo [8] in chess allowing to converge the sequences of chess players to the best of them wrt absolute tournament among all of them.

In other words, it was proven that knowledge-based rg cognizers can progress by local tournaments to the best ones in corresponding classes scaled wrt total tournaments between all class members.

Generalizing the above assertion can allow us to claim that an analogous statement on suitable measuring also be argued for the progress of generalized cognizers in the frame of an adequate theory of cognizing.

1.3.3. Such a theory we, analogously to the theory of algorithms, ground on generalized constructive models *cogs* of acknowledged Piagets descriptive models *pcogs* of human cognizing *hcogs* and specifying *mentals*, as constructive models of mental structures, state that:

- *constructive generalized models* cogs *of human cognizers* hcogs *can be arguably grounded on Piagets descriptive models* pcogs *of* hcogs;

- *there are premises that generalized* cogs *including the ability of learning* mentals *constructively and adequately model stabilized and developmental aspects of Piagets descriptive models* pcogs *including learning of mental structures (mss)* [9, 10].

1.4. In what follows, we argue that, analogous to chess, suitable measuring of progress of cognizing is also valid for the progress of generalized cognizers.

Consequently, we remind the argument in [9] that combinatorial games can serve as acceptable models of means of cognizing the Universe U; therefore *humans cognizing* pcog *of* U *can be approximated by cognizing combinatorial games, particularly, by rg reproducible subsets of such games and corresponding* rgcogs *models of* cogs *and:*

- *cognizing of combinatorial games, particularly chess, can properly approximate human cognizing, thus approximating the theory of cognizing.*

Then, listing some advances in cognizing of chess, we remind the theorems on locally progressing knowledge–based chess cognizers to the best in target classes and argue a trajectory of their proving to avoid the sophisticated one in [4], concluding with the targets for research.

2. Arguing Cognizing as Combinatorial Games

2.1. The entire Universe and new target **problems appear to humans** *combinatorically* because they need to be analyzed not in the frame of absolutely reliable conceptual frameworks, but with involvement of the entire ad hoc knowledge and means of its enrichment.
2.1.1. Such problems, if lucky, can be completely resolved. For example, in our practice [32], such a complete solution was found for Schroders combinatorial problem on specifying the systems of sets with a min number of subsets, where the proof followed from the proofs of the chain of 36 lemmas (reminding also the proof of Nadareshvilys chess etude required the analysis of chess tree in the about 39 depths [11]).

Unfortunately, combinatorial problem, generally, appear as intractable, why are resolved only fragmentarily for sub-problems, which, as a rule, are too local and do not illuminate the solution of the original problem. Nevertheless, some combinatorial classes are extractable, which satisfy additional requirements, allowing the development of theories and tractable algorithms common to these classes .
2.2. Then, the problems and dynamicity of the entire Universe U, ideally, appear to humans by realities affected by a variety of bundles b of known and possibly unknown doers, as a rule, complemented with doers *hcogs* of cognizing these realities.

These effects in time realities humans represent by classifiers of so far gained mss. Namely, *do-* and *systemic* classifiers of mss altogether comprise communalized, thus, estranged-able from particular members *x@C, attributes*, while the activated attributes, *situations*, operable, and communicably represent the peculiarities and relationships of the observable Universe U reflected, particularly, in sentences and phrases of languages.
2.3. Ideally, situations of U appear to humans h as activated at times t classifiers and relationships, particularly, cause-effect ones, so far gained by h afore t. Consequently, the possibilities of humans to reason on the Universe U and prognosticate decisions at time t are bounded by these ad hoc cognized classifiers and relationships, or **ad hoc cognizable universe (ahcU)**.

Seemingly, this ahcU idealization addresses issues rooted in Platos plate and Vernadskys noosphere comprehensions of the cognized and cognizable, Blavatskys cosmic mind [12], as well as Herbrands model of possible propositional inferences [13] and Wolframs *ruliard* "…the abstract object corresponding to the entangled limit of all possible computational processes: the result of following all possible computational rules in all possible ways [14].
2.3.1. However, in the **real** human universe U, interactions and cognizing of U are apparently processed locally. People, professionals, experts are goal-oriented and work with local sets of relevant attributes, thus, with situations and corresponding local problems, and try to resolve them by so far gained mss. Otherwise, if these attempts fail, people associate them with further cognizing of the problems to enrich mss and become more successful.
2.4. Thus, given situations p, certain utilities, bundles b of doers/actors and their possible doings in corresponding problems P, thus, changes/transformations of p at times t caused by b, the experts, in agree with mss gained before t, can prognosticate possible trajectories/branches of changes of p in time t by local trees T_s of situations allowing them to examine T_s for the most perspective trajectories of decisions in p and do correspondingly to solve the problems P.
2.4.1. Moreover, when experts in situations p of T_s aim to prognosticate strategies of actions for particular doers d and utilities, they for each action a of d consider all expected responses of the rest $b \setminus d$ doers of b in p with corresponding possible changes of p allowing to transform

the trees T_s of situations into games on T_s, which comprise all possible strategies of d in interactions of d with $b \setminus d$, thus, to search for the best strategies for d to solve P.

2.4.2. Such games allow experts to preliminarily process the expected versions of strategies of solutions in the framework of the models of problems, i.e., the framework of gained experience on peculiarities of situations of the problems, compare the strategies, choose the most promising of them and apply, instead of riskier immediate elaboration of strategies induced by widespread reasoning common for any situation. And because IDs of mss are communalized, experts can communicate them, i.e., explain and understand mss of each other, thus, collaborate for more effective solutions.

2.4.2.1. For example, in oligopoly competitions producers, say A, B, C, D ones, influence the market situations by bundles of 4P – price, product, promotion and proliferation, actions. Such competitions can be modeled by trees of situations, which focus on the benefits and strategies, for example, for A, can be transformed into game trees, where for each action of A in p, all possible responses of B, C, D will be branched along with corresponding changes of p [10].

While game trees only approximate oligopoly competitions, in chess, where white and black doers possess predetermined actions of available pieces on the chess board and lists of doings of each piece in each situation, game tree models represent chess game adequately.

2.5. Resuming, we state:

St. 1. *Ideally, humans* hcogs *cognizing of the Universe U can be modeled by cognizing global combinatorial games gG on global gT_s trees of situations, which, in turn, are comprised of real $hcogs_i$ cognizing of local sub-games lg_i $(i = 1, 2, \ldots, n)$ of gG on the corresponding local sub-trees lT_{s_i} of situations of gT_s altogether covering the global gT_s ones.*

2.5.1. Addressing the theory of cognizing statement St.1., lets assume:

Cl. 1.1. *The theory of cognizing local combinatorial sub-games lg_i $(i = 1, 2, \ldots, n)$ of the global gG ones by adequate constructive models of $hcogs_i$ can, in principle, be adequate to constructive models for the entire theory of cognizing.*

2.6. Then, addressing the outputs o_{gc} of gU cognizing, i.e., gU gained mss, lets state that, generally, only the composition of outputs o_{lc_i} of o_{lc_i} cognizing of individual local sub-games lg_i, i.e., lg_i gained mss, can represent o_{gc}, since, generally, o_{lc_i} vary by varying lg_i.

Particularly, o_{gs} can be enriched by mss common for all lg_i. This reasoning is similar, for example, to revealing that the mosaic is glass-made by analysis of its variably colored, but commonly glass–made units.

In contrast with o_{lc_i}, the means of cognizing m_{gU} and m_{lc_i} of gU and lg_i, correspondingly, can be accepted as equal.

Indeed, interpreting cognizers *hcogs* as the means of cognizing, then recalling Piagets argument that in solving problems, *hcogs* throughout the entire life are governed by universal laws, then follows the equality of *hcogs* wrt cognizing of global and local games, which allows to assume:

Cl. 1.2. *Adequate constructive models of $hcogs_i$ for cognizing local combinatorial sub-games lg_i $(i = 1, 2, \ldots, n)$, in principle, can approximate adequate constructive models of* hcogs *for cognizing the entire Universe U.*

2.7. Then, accepting that local games lg_i, while varying in their domains, thus, in outputs o_{lg_i}, assumingly, have equal cognizers, it is worth to assuming:

Cl. 1.3. *The accuracy of approximation of* hcogs *by cognizers $hcogs_i$ of classes of diversified local games lg_i having equal cognizers rises with rising the power of these classes and possibly dense coverage of gG by them.*

2.7.1. Following this implication, lets introduce a class of reproducible local games, argue its consistency with the requirements of corollaries Cl.1.1–3, followed by positives for the theory of cognizing inferred from this consistency.
2.8. Analogously to games with perfect information, the **rg class of** *reproducible* **games** is identified in [4, 15] by the following requirements:

- there are (a) interacting actors (doers, players, competitors, etc.) performing (b) identified types of actions at (c) specified moments of time and (d) specified types of situations,
- there are identified benefits for each of the actors,
- the situations perceived by actors of the games and those after their acting have to be specifiable by if-then rules, allowing for regular experimentation with them .

2.8.1. It appears that rg class among chess-like games a suitable for approximating massive application problems in competition, defense, and dialogue, including intrusion protection, marketing, craft defense, tutoring, testing of programs, and, as a rule, there were no difficulties in their proper, or quasi-adequate rg representation [4].

Studies of knowledge-based solutions for such, explicitly or not, identified combinatorial games rooted in the Theory of Games and Shannons works in chess [16], are presented, particularly, in [4, 17, 18, 19, 20, 21, 22].

Even more, rg class can be properly extended, allowing, for example, the appearance of situations that are not only strongly deterministic, but also have some proximity and likelihood.
2.8.2. Hence, we assume:
Ass.1. *Games of rg class and their extensions quasi-adequately approximate the coverage of local lg sub-games of the global gG games.*
2.8.3. Then, following St.1. and Ass.1., it is reasonable to expect that properties common in rg cognizing, at least, approximate *hcogs* cognizing of the Universe U, allowing corollary Cl. 1.2. to proceed to the following assumption:
Ass. 2. *The theory of* hcogs *cognizing of games of rg class based on common properties of the means and outputs of rg cognizing can approximate adequate models* $hcogs_U$ *of* hcogs *cognizing of* U.
2.9. Consequently, it is worth the addressing the impacts on generalized cognizing by cognizing of reproducible games.

Thus, succeeding Ass. 2., it is reasonable to reveal common properties of means and outputs of rg cognizing, followed by conveying rg common of them to the models approximating cognizing the Universe.

3. Impacting to the Means of Generalized Cognizing by Cognizing Local Games

3.1. To achieve these goals, let's preliminarily acknowledge that generally and from rg experimens[4] –[31] follows that
St. 2. *Rg games differ semantically in the attributes of situations of the trees and the cause-effect rules of transitions between them, Therefore, they generally, require cognizing approaches appropriate to particular games,*

while to state

St.3. *Rg games can be syntactically modeled using game trees and have similar strategy search algorithms induced by the structures of these trees.*

3.2. Thus, it follows that, at least, strategy-search-based properties of cognizing are rg common and studying such rg cognizing can be arranged for each rg representative, **rg-kernel**, followed by dissemination of the results to the entire rg class, then, moreover, to approximate adequate models of hcogs cognizing of U ($hcogs_U$).

3.3. Then, rooting in Zermelo's studies [18] and those, particularly, in [4]-[8], [10, 11], [16, 17], [19]–[31], chess historically is acknowledged as convenient model, i.e., rg-kernel, for revealing common properties of means and outputs of rg cognizing.

Resuming, it follows that

Ass. 3. *Strategy–search–based properties of cognizing are rg common and studying rg cognizing can be arranged for the chess rg-kernel, followed by dissemination of the results to the entire rg class.*

3.4. Correspondingly, let's list some chess **properties common in rg cognizing.**

St. 4. *Chess games can be approximated by finite game trees.*

St. 5. *Chess trees comprise all possible strategies of chess.*

St. 6. *Situations of chess trees are strongly divided into three classes: winning, losing, or drawing.*

St. 7. *Comprehensive outputs of cognizing chess, or comprehensive knowledge of chess (cck) encompass classifiers of values of each chess situation and corresponding cause-effect chains, strategies, for attaining these values, thus, allowing to play in absolutely effective ways wrt all other strategies.*

3.5. Consequently, along with commonality of St. 2–7 let's comprise properties so far gained in cognizing of chess, properly rg extend them, followed by focusing on ongoing and intended chess studies arguably relevant to the theory of $hcogs_U$.

St. 8. *Ideally, there are perfect chess solvers with strategies possessing comprehensive knowledge of chess, cck.*

3.5.1. Consequently,

St.9. *These perfect chess solvers become the winners of ideal absolute tournaments between all chess solvers, ordered wrt points each solver gained in games with all others.*

3.5.2. Extending St. 8. allows us to assume

Ass. 4. *The ordering of chess solvers by points gained in absolute tournaments is in accordance with the decreasing of the quality and quantity of the fractions of cck they possess, thus*

Ass. 5. *The degrees of success of rg solvers are directly proportional to the degrees of quality and quantity of the fractions of comprehensive chess knowledge they possess, and therefore, directly proportional to the progress in cognizing of cck by cognizers cogs of rg solvers.*

3.5.3. Ass. 4–5 are supported by analysis of a wide-ranging repository of chess vocabulary units [10] allowing us to state:

St.10. *Classifiers of the values of chess situations, plans and strategies of chess experts can be interpreted as classifiers of constituents of comprehensive chess knowledge cck and their qualification degrees correspond to the quality and quantity of the fraction of cck they possess.*

3.5.3.1. Another argument supporting Ass. 4–5 follows from Elo's analysis of game results of chess players, allowing him to introduce a measure, Elo's rating, qualification of players wrt absolute tournaments, while measuring it by means of only minor complexity local tournaments between them [4].

3.5.3.2. In parallel, introducing in [4] a hypothesis analogous to Elo's one, based on proven cck theorems, stating, particularly, that in classes A of algorithms allowing enumeration of all possible appearances of algorithms of A by enumeration of states of variables, regulators, determining any of their appearances, it is possible to arrange the sequences of local tournaments between all possible appearances of algorithms, similar to those used by Elo in chess, converging to the strongest algorithms in A.

3.6. The analysis of the repository of chess vocabulary units also lets us accept the following statement:

St. 11. *The likelihood of expert classifiers wrt the ideal ones, as a rule, is small because precise determination of the values of the realities requires generating and evaluating the corresponding strategies, which are computationally hard problems.*

And, consequently, we accept the following assumption:

Ass.6. *Values of chess classifiers, in principle, cannot be even for all experts, and classifiers of experts along with common constituents, which include an essential part of subjective ones.*

3.7. Applications and experiments with competition, defense and dialogue rg problems rooted in cognizing of chess and summarized in [10], can be stated as follows:

St.12. *Properties by St. 1–11 and Ass. 1–6 revealed in cognizing chess can presumably be extended to the entire rg class by properly replacing chess expressions in them with those of targeted rg representatives and chess values with corresponding utilities.*

3.8. Thus, the corollaries of St. 12. are as follows:

Cl.12.1. *Humans* hchcogs *cognizers of chess can properly approximate* hcogs *rg cognizing, thus also approximating the adequate models of* $hcogs_U$.

Cl.12.2. *The theory of chess cognizing, based on the models* hchcogs, *can approximate the entire constructive theory of cognizing.*

3.9. Let's now recall the theorems on the progress of chess cognizers by local tournaments, as provided in Appendix 1, a trajectory of their less sophisticated proof, followed by conclusions and some actual targets for further research.

4. Progress of Chess Cognizers in Local Tournaments

4.1. Interpreting Elo's hypothesis in [8], the theorems on ordering chess strategies by local tournaments were induced based on the assumption that the proportions of wins, draws, and losses of a given control search strategy f in rg games with arbitrary other strategies, given a fixed initial position P, are directly proportional to the proportions of terminal vertices of the corresponding types in the strategy generated by f from P.

4.1.1. Consequently, the problem of comparing the "strength" of two given strategies, f_i and f_j, is reduced to the problem of establishing the relative positions of these strategies in a sequence obtained by linearly ordering the chess strategies based on the results of an absolute tournament. The latter is understood as a round-robin tournament between all possible chess strategies, where each pair of strategies meets in a match under special conditions that ensure that no a priori advantage arises for either strategy due to the nature of the match organization.

4.1.2. Then, by analogy with Elo, a hypothesis was put forward on interdependencies of knowledge-based strategies in absolute tournaments, stating that based on the position i of given strategy f_i in an absolute tournament, a constant b_i can be specified such that f_i only loses games to the left of the neighborhood $(i + b_i, i - b_i)$, wins to the right, and it can both win and lose within the neighborhood. The following theorem was proved:

Theorem 1 (page 152, [4]). *For arbitrary strategies f_i and f_j, if f_j wins the game against f_i and there exists a set of strategies F' such that*

- *the power of F' is greater than b_i*
- *f_j wins and f_i loses games with every strategy in F' in the round-robin, absolute tournament for $F' \cup \{f_i, f_j\}$,*

then f_j is stronger than f_i wrt the absolute tournament between all chess knowledge–based strategies.

A similar statement holds for f_i and f_j games that end in draws.

4.1.3. Thus, the question of testing whether a given strategy f_j strengthens the original f_i reduces to constructing the set F' and estimating the parameter b_i.

Even without estimating b_i, it can be stated: the larger $|F'|$, the more likely it is that f_j is stronger than f_i. This last statement provides the necessary foundation for an experimental study of strategy strengthening.

It should also be noted that, following Ass.3, these results can be extended to the entire rg strategies, too.

4.2. In [4], the solvability of the Shannon chess adaptation problem (SAP) was also proven, interpreted as a requirement to arrange the sequences of local tournaments between chess algorithms of classes A analogous to Elo ones for chess players, which under suitable restrictions on the locality, i.e., on the number $\Delta(t)$ of elementary calculations in local tournaments at time t, will converge to the strongest algorithms in A.

4.2.1. Solvability was proven without requiring a strictly sequential strengthening of hypotheses of A in tournaments and assuming that samples of A could be provided by some algorithms with a finite number l of parameters, *regulators* of the provisions.

The latter allows one to construct a procedure for enumerating all combinations of algorithms of A and sequentially checking them for the presence of algorithms stronger than the current algorithms – a hypothesis, to converge in the limit to the strongest of the algorithms in A with a certain accuracy.

4.2.2. More precisely, let c be the maximum number of elementary calculations when performing arithmetic operations or comparing two numbers, and let c_m and c_g be those required to play one game and transit to algorithms from their numbers, respectively.

4.2.3. Let's also accept that algorithms ω resolve the SAP in classes A with accuracy m if, in the limit, the solutions $\omega(A)$ are weaker than the best algorithms in A at no more than m places wrt absolute tournaments.

Under these conditions, Theorem 2 was proved

Theorem 2 (page 158, [4]). *The SAP adaptation problem in classes A of chess algorithms generated by l regulators is solvable with accuracy $2b$ if, at least,*

$$\Delta(t) \geq 2c_m b^2 + 5cb(1 + \log_l(t + b + 2)) + c_g b$$

4.3. The proof of Theorem 2 relies on the technique of producing sequences of compacted and not–coinciding k–element subsets of the finite n naturals, $k < n$, presented in [32] and [10].

Avoiding the complexity of interpretation of this technique presented in [4], while demonstrating the viability of the theorems, Chapter 6 provides an outline of a parallel trajectory of the basics of the proof for the chess rg kernel.

5. Conclusions and Targets

5.1. Theorem 1 provides an explicit, simple measure of ascending order of a group of game strategies in scales induced by tournaments among all possible strategies in the focused game trees.

In contrast to conservative situation trees of chess, such rg and cogs trees can vary depending on the revealed and dated classifiers of situations and relations between them.

Nevertheless, these trees, as a rule, remain stable for some periods of time, allowing for the development, analysis, and comparison of strategies based on the aforementioned local tournaments.

5.2. Particularly, by extending Theorem 2 and assuming that the class of algorithms A contains the highest generalized cognizers $cogs^*$ the search for $cogs^*$, analogously to chess, can be arranged by enumerating possible states of leverages of algorithms of A along with the technique for extracting all possible bundles b from A of these algorithms, thereby guaranteeing the convergence of the winner cogs of the tournaments to $cogs^*$.

5.2.1. A step to $cogs^*$ could provide the acquirers of the thesauri of communities, as well as their enrichment through discovery, revealing and other leverages for gaining new mss. Particularly, a generative pre-trained transformer such as ChatGPT is worth considering for these aims.

5.3. The evolutionary directed development of diversified versions of cogs, particularly, octaves to $cogs^*$, using measurements obtained in local tournaments, also appears promising.

5.3.1. In chess interpretation, given any starting chcogs C_o with certain functional units, experts preserving the root utilities of C_o can diversify the performance of the units of C_o and form the class $\{C_o\}$ of chcogs.

Applying the package of evolutionary transformers T_e, including parenting and mutations, to $\{C_o\}$, they will get new class $\{C'\}$ of chcogs.

Arranging local tournaments T_r for bundles of $\{C'\}$ experts will find the class of winners $\{C'_w\}$ wrt T_r.

Applying T_r to $\{C'_w\}$, they will get a new class $\{C''\}$ to continue the process recurrently.

Expectedly, such an evolution process will converge to the best chcogs Ch^* in the classes created in this way.

5.3.2. For developing octaves O_{ch}, the experts can arrange the learning and growth of O_{ch} in a variety of environments E_i to get the corresponding class $\{C_1\}$ of chcogs.

Through tournaments T_r in $\{C_{1w}\}$, winners in $\{C_1\}$ can be found to continue the process recurrently, while these learning and evolutionary approaches can be combined.

5.4. Concluding, let's recall the assumption that possibilities of humans to reason about the Universe U and prognosticate decisions at time t are bounded by ad hoc cognized classifiers and relationships, or ad hoc cognizable Universe (ahcU).

Then, it was argued that humans hcogs cognizing of the Universe U can be modeled by cognizing local sub-trees T_{s_i} of situations of the global tree gT_s altogether covering the cognition of gT_s.

Thus, given trees T_{s_i} of situations of problems p_i with target situations s_s, ideally, the perfect strategy S_i^* for p_i from s_s at time t can be calculated for a certain depth h of T_{s_i}.

Despite calculations of S_i^* increases exponentially with the rise of h, and hence the power of S_i^* is bounded by the power of computers, this approach can be viable since in applications p_i the depth h is often restricted, while the power of computers increases tremendously.

6. Appendices: A Trajectory of Proving Theorems 1–3

6.1. Recall that in the SAP *Shannon's chess adaptation problem*, it is required to arrange the sequences of local Elo's type tournaments between chess algorithms of A, which, under suitable restrictions on the locality, i.e., on the number $\Delta(t)$ of elementary calculations in local tournaments at time t, will converge to the strongest algorithms in A.
6.1.1. Let us denote that

chG – chess game tree

h – the depth of game trees

n – branches of the nodes

n^h – number of strategies of chG.

6.1.2. Then,

l – the number of leverages, regulators inducing cognizers of chG

m_i – the range $[a_{i1}, a_{i2}, \ldots, a_{im_i}]$ of states of the x_i leverage, or x_i variable, $i \in [1, l]$ and $m \geq m_i$

A – the set of chess solvers, algorithms (chalgs) l-produced and stabilized in learning chG versions of chess cognizers chcogs

m^l – the number of possible l-produced chalgs, thus, the number of elements of A.

6.1.3. Denote also d and b as naturals such that $d > 2b$ and b is the length of the zone of uncertainty of i-th player in ordering according to the absolute tournaments of all cognizers of A

$\binom{m^l}{d} = \frac{m^l!}{(m^l-d)!\,d!}$ – a combination of m^l things d at a time is the number of local d size tournaments in examining the strength of players.

6.1.4. Each chalgs realizes a strategy in chG, why the number of different chalgs can be, at least, even to n^h in the case if l-produced chalgs of A realize all strategies of chG, i.e., $m^l < n^h$ or $m^l = n^h$.

6.1.5. Consider enumeration E_1 of l-positioned numbers corresponding to the indices i of x_i, $i \in [1, \ldots, m_i]$, which sequentially lists all n possible l-bundles of indices of states of x_i variables, thus, all l-bundles of chalgs of A, starting from the number $1, 1, \ldots, 1$ with 1 in all l positions.

For example, if $m_i = 10$, of l-bundles of indices $b_1, b_2, \ldots, b_L$ in decimal scale of enumeration E_1 will start with the decimal number $10^l + 10^{l-1} + \ldots + 10 + 1$ and, generally, correspond to the decimal number $b_l 10^l + b_{l-1} 10^{l-1} + \ldots + 10 + b_1$.

If the scales are not decimal, i.e., $i \in [1, 2, \ldots, m_i]$, the decimal number of l-bundle $b_1, b_2, \ldots, b_l$ will be equal to $b_l(m_{l-1} \ldots m_2 m_1) + b_{l-1}(m_{l-2} \ldots m_2 m_1) + \ldots + b_2 m_1 + b_1$ and the number n of all l-bundles will be equal to $m_L \ldots m_2 m_1$.

Apparently, chalgs of A get unique numbers, code in E_1, and can be unanimously decoded.

6.2. Let T_A be the ordering of all chalgs of A as the result of the ratings they gain in an absolute tournament for all chalgs of A, where each chalgs competes against all the others in A.

Let d, b also be naturals such that $d > 2b$, where b is the max number of places on the left and right of any i position in T_A that games of i with j in the range of $2b$ are uncertain by the results, i.e., i either wins j or loses j [4].

6.3. For the set E_1 of $1, 2, \ldots, n$ of all chalgs of A, let E_2 be a compacted, lexicographic enumeration of all possible d-bundles of different, not coinciding chalgs of A.

Addressing the definitions in [4] for E_2 lexicographic enumeration, let's provide an example of it for $n = 5$ and $d = 3$: 123, 124, 125, 134, 135, 145, 234, 235, 245, 345.

6.4. Following E_2, let's sequentially take d-bundles of E_2, for each b_t of them provide an exhaustive tournament, i.e., each chalgs competes with all others of b_t, then in the ordering o_{b_t} of strategies of these chalgs to examine, whether o_{b_t} meet the requirement that the winner w_{b_t} of o_{b_t} won each other in b_t, while the min rating player l_{b_t} lost to any of b_t.

According to [4] it follows that w_{b_t} has a higher position in the absolute T_A tournament than l_{b_t}.

Thus, in the search for the best s^* in A, we can exclude l_{b_t} from further examination.

6.5. To examine the viability of w_{b_t} as the best chalgs, let's provide tournaments involving w_{b_t} and, sequentially, each d-bundle of E_2 until the $d+1$-bundle $b'_{t'}$ is found, where the winner $w'_{b'_{t'}}$ with max rating wins all others in $b'_{t'}$, while w_{b_t} loses to all of them.

Thus, $w'_{b'_{t'}}$ in T_A is higher (stronger) then w_{b_t}, so that w_{b_t} can be excluded from further examination.

6.6. Continuing the above series of local tournaments, eventually we'll find $\hat{w}_{\hat{b}_{\hat{t}}}$ that, during exhaustive searching of E_2, will not be defied by chalgs of $\hat{b}_{\hat{t}}$, and thus can be considered as an approximation to s^*.

6.7. Along with looking for new selection criteria guaranteeing s^*, heuristics can be applied to indicate chalgs better than $\hat{b}_{\hat{t}}$.

For example, we can weaken the requirement that $\hat{w}_{\hat{b}_{\hat{t}}}$ is beaten by all chalgs of $\hat{b}_{\hat{t}}$ and trade off different options for the % of such events.

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Ընդհանրացված իմացիչների համար չափելի մրցաշարերի մասին

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Ամփոփում

Հետազոտողներ Կուրցվեյլը և Գյորտցելը, կանխատեսում են, որ արհեստական բանականությունը (AI) մտնում է արհեստական ընդհանուր բանականության (AGI) էքսպոնենցիալ աճի շրջան:

Նրանք կարծում են, որ եթե նման AGI-ը կարողանա վերաշարադրել իր սեփական կոդը, այն կարող է զարգանալ որպես գերմարդկային արհեստական բանականություն, որը կունենա բոլոր մարդկային քաղաքակրթությունների ճանաչողական և հաշվողական ուժը:

Մենք AGI-ի այս պահանջը մեկնաբանում ենք որպես ընդհանրացված իմացիչների անխուսափելի ունակություն՝ ստեղծելու իրենց փոփոխությունների սպասելիորեն ողջամիտ տարբերակներ՝ այդ տարբերակները չափելու վստահելի միջոցներով և դրանցից ամենախոստումնալիցները ընտրելու ճանաչողների օգտակարության վերաբերյալ:

Ընդհանրացնելով մեր նախորդ պնդումը, որ գիտելիքների վրա հիմնված շախմատի ռազմավարությունները կարող են ուժեղ կերպով մաuշտաբավորվել տեղական մրցաշարերի միջոցով, մենք հիմնավորում ենք նմանատիպ պնդում՝ ընդհանրացված իմացիչների առաջընթացի համապատասխան չափման համար՝ իմացիության համարժեք տեսության շրջանակներում, և անդրադառնում ենք դրա զարգացման ուղիներին:

Բանալի բառեր՝ AGI, ընդհանրացված իմացիչներ, առաջընթացի չափում, տեղական մրցաշարեր, բացարձակ կարգավորումներ:

Об измеримых турнирах для прогрессирующих обобщенных познавателей

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Аннотация

Исследователи, такие как Курцвейл и Гертцель, предсказывают, что ИИ, благодаря прогрессу LLM, вступает в период экспоненциального роста в сторону искусственного общего интеллекта (AGI).

Они считают, что если бы такой AGI мог переписывать свой собственный код, он мог бы эволюционировать в сверхчеловеческий ИИ, обладающий когнитивной и вычислительной мощью всей человеческой цивилизации.

Мы интерпретируем это требование к AGI как неизбежную способность обобщенных познавателей генерировать ожидаемо разумные версии модификаций самих себя, с надежными средствами измерения этих версий и выбора наиболее перспективных из них, с точки зрения полезности познавателей.

Обобщая наше предыдущее утверждение о том, что основанные на знаниях шахматные стратегии могут быть сильно масштабированы локальными турнирами, мы выдвигаем аналогичное утверждение для подходящего измерения прогресса обобщенных познавателей в рамках адекватной теории познания, и рассматриваем способы ее усиления.

Ключевые слова: AGI, обобщенные познаватели, измерение прогресса, локальные турниры, абсолютный порядок.