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(54) Title: ALIFE MACHINE LEARNING SYSTEM AND METHOD

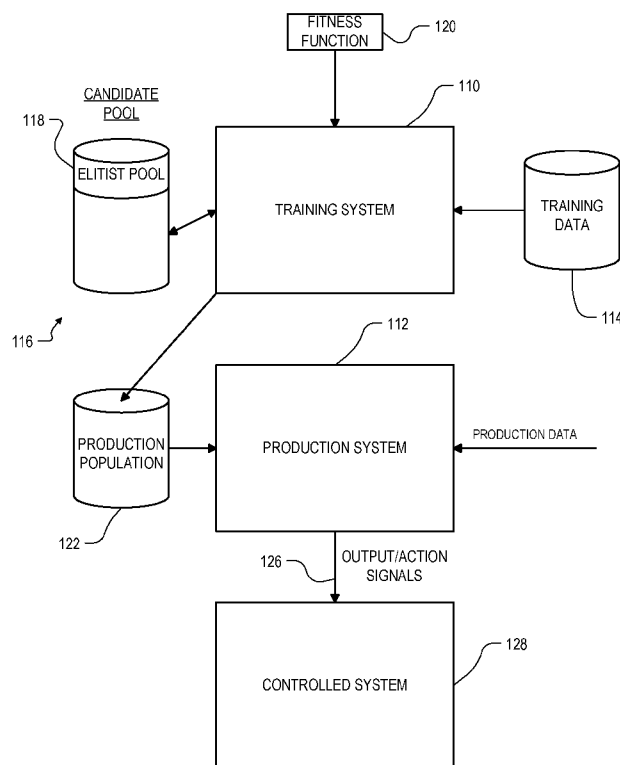


FIG. 1

(57) Abstract: Roughly described, a problem solving platform distributes the solving of the problem over a evolvable individuals, each of which also evolves its own pool of actors. The actors have the ability to contribute collaboratively to a solution at the level of the individual, instead of each actor being a candidate for the full solution. Populations evolve both at the level of the individual and at the level of actors within an individual. In an embodiment, an individual defines parameters according to which its population of actors can evolve. The individual is fixed prior to deployment to a production environment, but its actors can continue to evolve and adapt while operating in the production environment. Thus a goal of the evolutionary process at the level of individuals is to find populations of actors that can sustain themselves and survive, solving a dynamic problem for a given domain as a consequence.



LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK,
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GW, KM, ML, MR, NE, SN, TD, TG).

— *before the expiration of the time limit for amending the
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INTERNATIONAL SEARCH REPORT

International application No.

PCT/IB16/01060

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - G06N3/08; G06N3/12 (2016.01)

CPC - G06N3/086; G06N3/08; G06N3/126

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC(8) Classifications: G06N3/08; G06N3/12; G06Q10/06 (2016.01)

CPC Classifications: G06N3/086; G06N3/08; G06N3/126; G06N3/12; G06N99/005; G06Q10/06

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PatSeer (US, EP, WO, JP, DE, GB, CN, FR, KR, ES, AU, IN, CA, Other Countries (INPADOC), RU, AT, CH, TH, BR, PH);

Google/Google Scholar; IEEE/IEEExplore; EBSCO Non-Patent Prior Art Source; KEYWORDS: candidate, individual, parameter, evolve, pool, actors, training, deploy, assert, action, subset

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 8,909,570 B1 (HODJAT, B et al.) 09 December 2014; Abstract; Figures 1, 2, 4-6; Column 4, lines 1-4; Column 7, lines 34-36; Column 10, lines 10-17; Column 13, lines 4-13; Column 15, lines 7-66	1, 11
A	US 2009/0125370 A1 (BLONDEAU, A et al.) 14 May 2009; entire document	1, 11
A	US 2010/0293119 A1 (FERRINGER, M et al.) 18 November 2010; entire document	1, 11

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

3 November 2016 (03.11.2016)

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/IB16/01060

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Group I: Claims 1 and 11; Group II: Claims 2-10

---Continued within extra sheet---

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1 and 11

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

-Continued from Box III: Observations where unity of invention is lacking-

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fee must be paid.

Group I: Claims 1 and 11 are directed towards a system evolving actors in dependence upon training data and given individual parameters to assert actions dependent on a response of actors of the deployed individual.

Group II: Claims 2-10 are directed towards a system for testing each individual processing its actors through $N > 1$ actor level cycles with actors collaborating to assert an action, updating the individual fitness estimate in a battery of trials, and discarding and deploying selected individuals.

The inventions listed as Groups I-II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

The special technical features of Group I include at least for each given one of at least a subset of the candidate individuals: evolving the parameters of the given individual in dependence upon the training data, and evolving each of the actors of the given individual in dependence upon the training data and further in dependence upon the parameters of the given individual; and a production system: operating a deployed one of the individuals from the pool of candidate individuals to assert actions in dependence upon the production data, the actions asserted by the deployed individual being dependent on a response of the actors of the deployed individual to the production data, and further evolving the actors of the deployed individual in dependence upon the parameters of the given individual and the production data, which are not present in Group II.

The special technical features of Group II include at least each candidate individual further having associated therewith an indication of a respective fitness estimate; a candidate pool processor which: applies the training samples to individuals from the candidate pool, each individual being tested processing its actors through $N > 1$ actor-level cycles of activity in response to each of the data entries, the actors of the individual collaborating to assert an action for the individual in response to the data entry, and updates the fitness estimate associated with each of the individuals being tested in dependence upon both the training data and actions asserted by the respective individual in the battery of trials; a competition module which selects individuals for discarding from the candidate pool in dependence upon predefined criteria; and a candidate harvesting module providing for deployment selected ones of the individuals from the candidate pool, which are not present in Group I.

The common technical features shared by Groups I-II are a computer-implemented data mining system, for use with a data mining training database containing samples of training data, each of the samples having at least one data entry, comprising: a candidate database having a pool of candidate individuals, each candidate individual having a respective pool of actors and a respective set of parameters which influence evolution of the actors in the respective pool of actors.

However, these common features are previously disclosed by US 8,909,570 B1 to HODJAT et al. hereinafter ("Hodjat"). Hodjat discloses a computer-implemented data mining system, for use with a data mining training database containing samples of training data, each of the samples having at least one data entry (computer implemented data mining system including a training database having samples in training data 114 showing raw data (data entry); Abstract; Figure 4; Column 4, lines 1-4; Column 7, lines 34-36; Column 10, lines 10-17), comprising: a candidate database having a pool of candidate individuals (a candidate database of individuals from a candidate gene pool; Abstract), each candidate individual having a respective pool of actors (candidate individuals include those in a layer below an elitist pool (a respective pool of actors); Column 4, lines 53-59) and a respective set of parameters (each candidate individual has a respective fitness estimate (respective parameters); Abstract) which influence evolution of the actors in the respective pool of actors (used in a competition module to assign individuals at each layer with respect to the elitist pool (influence evolution of the respective pool of actors); Figure 6; Column 13, lines 4-13).

Since the common technical features are previously disclosed by the Hodjat reference, these common features are not special and so Groups I-II lack unity.