Generalized LL parsing for context-free constrained path search problem

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Path querying is an actual problem in bioinformatic, graph databases, ... One of specific problem is formal languages path problem [1] which meens that paths constraints formulated as Query may be specified as context-free grammar: path $P = e_0, \ldots, e_n$, $\omega = e_0.tag \cdot \cdots \cdot e_n.tag$, $\omega \in L(G)$

Let we want to find all path with form $A^n B^n$. This constraint can not be specified with regular language as far as $L = \{a^n b^n; n > 0\}$ is not regular but context free. Required language can be specified by grammar G presrnted in picture 1.

```
s: A l | middle
middle: A B
l: s B
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Figure 1: Grammar G for language $L = \{a^n b^n; n > 0\}$

We propose a context-free language constrained path problem solution which allow to find all paths and construct implicit representation of result.

Our is based on generalized LL (GLL) [2] parsing algorithm which allow to process arbitrary context-free grammars. Complexity is $O(n^3)$ in worst case and linear for unumbigues grammars, that better then complexity of CYK and Erly which used as base in other solutions.

All-path semantic — SPPF constructed by algorithm contains all paths matched with specified constraints. SPPF for grammar G and graph M which presented in picture !!! is presented in picture !!!. Extensions allow to check whether path from u to v exists and extract it. For example ....

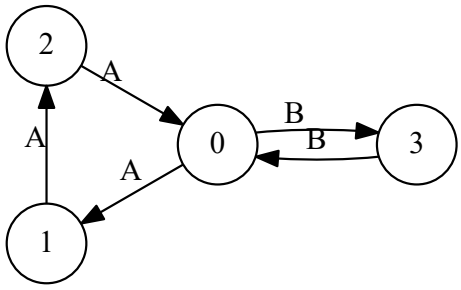

Figure 2: xxx

Full index — for dynamic graphs. It is necessary only recalculate ... This operation is native for basic algorithm.

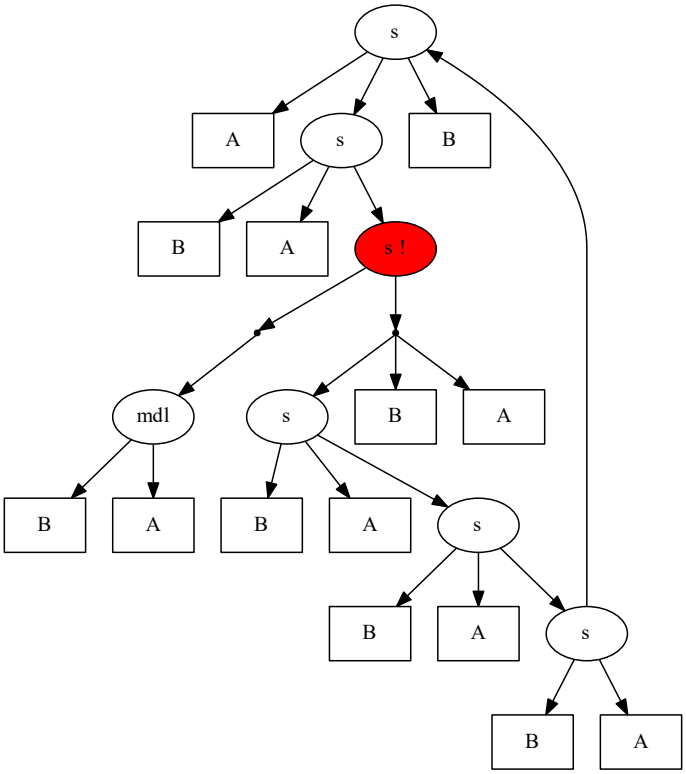

Figure 3: ccc

1. REFERENCES

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[2] Scott, E., & Johnstone, A. (2010). GLL parsing. Electronic Notes in Theoretical Computer Science, 253(7), 177–189.

[3] Hellings, J. (2014). Conjunctive context-free path queries.

[4] Hellings, J. (2015). Querying for Paths in Graphs using Context-Free Path Queries. arXiv preprint arXiv:1502.02242.