

## Letter of Intent and Previous Work

D. Gueorguiev, 03/18/2025

My interests include mathematical modeling via convex and combinatorial optimization, reinforcement learning, probabilistic models, graph theory and dynamic programming algorithms. Interested in using probabilistic methods for creating suitable estimators and root cause analysis.

Currently researching various GenAI algorithms and their applicability in certain contexts relevant to Nike.

Examples of my recent work and research interests are:

- a) redesign of the online Fulfillment algorithm using  $\epsilon$ -constraint method, replacing the weighted objectives method for scalarization, reformulating the problem as Mixed Integer optimization problem.
- b) research various reinforcement learning Policy Gradient algorithms such as PPO, applying those to Deployment Optimization and Fulfillment Optimization problems. For the purpose is using the gymnasium environment and stable-baselines3 library.
- c) research various algorithms for Root Cause Analysis using Bayesian inference and Probabilistic Temporal Logic. For the purpose exploring the usability of causal inference algorithms included in the packages causal-learn, causalml and dowhy.
- d) research and design classical and GenAI algorithms for various image processing tasks such as synthetic noise generation, generative fill and shadow processing.

Here are few documents reflecting my past work:

[https://github.com/dimitarpg13/personal/blob/main/previous\\_investigations/README.md](https://github.com/dimitarpg13/personal/blob/main/previous_investigations/README.md)

My coding experience involve python, C++, C, Java.

Samples of my python code can be found here:

algorithms for smooth gradient outpainting

[https://github.com/dimitarpg13/smooth\\_gradient\\_outpaint](https://github.com/dimitarpg13/smooth_gradient_outpaint)

image crop algorithm using object segmentation with the Dichotomous Segmentation Deep Learning model:

[https://github.com/dimitarpg13/image\\_crop](https://github.com/dimitarpg13/image_crop)

Here are samples of my C++ code from past endeavors:

[https://github.com/google/or-](https://github.com/google/or-tools/compare/stable...dimitarpg13:ortools:dpg/PWL_solver_stable_py2.7_gtest_scipV6)

[tools/compare/stable...dimitarpg13:ortools:dpg/PWL\\_solver\\_stable\\_py2.7\\_gtest\\_scipV6](https://github.com/google/or-tools/compare/stable...dimitarpg13:ortools:dpg/PWL_solver_stable_py2.7_gtest_scipV6)

<https://github.com/dimitarpg13/testcode/blob/master/fraction.cpp>

[https://github.com/dimitarpg13/testcode/blob/master/fraction\\_mt.cpp](https://github.com/dimitarpg13/testcode/blob/master/fraction_mt.cpp)

[https://github.com/dimitarpg13/testcode/blob/master/fraction\\_bigint.cpp](https://github.com/dimitarpg13/testcode/blob/master/fraction_bigint.cpp)

[https://github.com/dimitarpg13/cpp\\_testcode/tree/master/SudokuQlik/src](https://github.com/dimitarpg13/cpp_testcode/tree/master/SudokuQlik/src)

And here are relevant documents to software design, architecture, coding techniques and design patterns:

<https://github.com/dimitarpg13/BigIndex/blob/main/PresentationDGueorguiev2018.pdf>

[https://github.com/dimitarpg13/InsideTensorflow2Source/blob/master/Understanding\\_Tensorflow\\_2\\_source\\_code.pdf](https://github.com/dimitarpg13/InsideTensorflow2Source/blob/master/Understanding_Tensorflow_2_source_code.pdf)

<https://github.com/dimitarpg13/UnderstandingPythonEcosystem>

[https://github.com/dimitarpg13/inside\\_cpp\\_object\\_model](https://github.com/dimitarpg13/inside_cpp_object_model)

And here are few repos about C++ language details and features:

[https://github.com/dimitarpg13/cpp\\_effective\\_modern](https://github.com/dimitarpg13/cpp_effective_modern)

[https://github.com/dimitarpg13/cpp\\_move\\_semantics](https://github.com/dimitarpg13/cpp_move_semantics)  
[https://github.com/dimitarpg13/cpp\\_templates\\_complete\\_guide](https://github.com/dimitarpg13/cpp_templates_complete_guide)  
[https://github.com/dimitarpg13/cpp\\_random\\_pieces](https://github.com/dimitarpg13/cpp_random_pieces)

Additionally, in my free time I am looking into an implementation of *semantic simulation* for semantic search and semantic inference using reinforcement learning. Short description on Semantic Simulation can be found here:

<https://github.com/dimitarpg13/aiconcepts/blob/master/docs/SemanticStructures/README.md>  
<https://github.com/dimitarpg13/aiconcepts/blob/master/docs/SemanticStructures/SemanticSimulation.docx>  
<https://github.com/dimitarpg13/sensimula/blob/main/README.md>