

Deep Learning Report - Lab 3

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I. TASK 1 - EXPLORING OPTIMISATION OF ANALYTIC FUNCTIONS

A. Rastrigin Function

The rastrigin function is used to test the performance of optimisation algorithms. Finding the minimum of this function is challenging due to its large search space and a large number of local minima. The default value of 'A' equal to 10 in the Rastrigin function produces a very bumpy loss surface. The general formula of the function is given by:

$$f(x) = An + \sum_{i=1}^n [x_i^2 - A \cos(2\pi x_i)]$$

The rastrigin function of 2 independent variables with an 'A' value equal to 1 is depicted in figure 1.

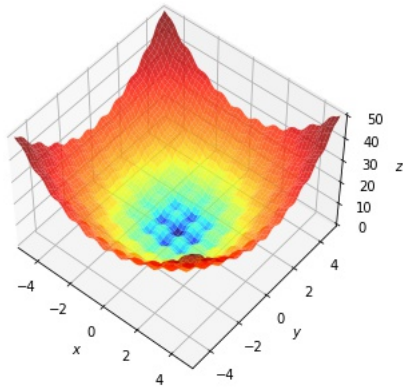


Fig. 1: Rastrigin function of 2 variables in 3D

B. Implementation of optimisers

Four different optimisers with different parameters were implemented. They are:

- 1) SGD (lr = 0.01)
- 2) SGD with momentum (lr = 0.01 , momentum = 0.9)
- 3) AdaGrad (lr = 0.01)
- 4) Adam (lr = 0.01)

All four optimisers were run with [5,5] as the starting point and for a fixed number of 100 iterations. The loss plot for each of these optimisers is shown in figure 2.

From the loss plot, it is clear that SGD with momentum works best to optimise the rastrigin function. It also reaches

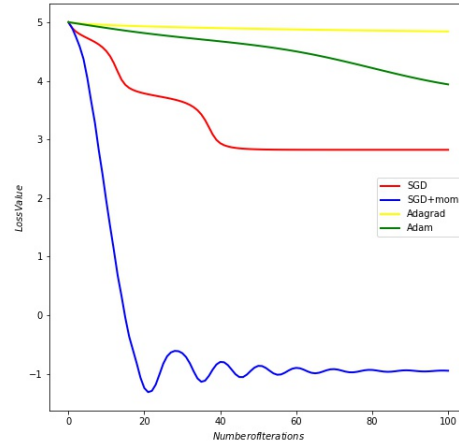


Fig. 2: Loss curves of the different optimisers

the minima in far fewer iterations than the other optimisers. Adagrad performs the worst in comparison to the other optimisers. It gets stuck at a local minima and fails to further optimise the function.

II. OPTIMISATION OF SVM ON REAL DATA

For this task, two classes from the iris dataset were chosen and the class labels were changed to +1 and -1. The data was split into training and validation set and the values were normalised. SGD with a learning rate of 0.01 and Adam with a learning rate of 0.01 were used to train soft margin linear SVM's with a weight decay of 0.0001 on the training data. The training batch size was set to 25 and the optimisers were run for a fixed number of 100 iterations. The weights were randomly initialised on every run and the scores for both the optimisers were averaged over 500 runs.

SVM with SGD obtained a validation score of 0.92 while SVM with Adam achieved a validation score of 0.86. On running the optimisers multiple times, adam showed a little variation in the scores obtained on individual runs whereas the scores obtained by SGD with momentum on successive runs was almost consistent. Even in the scenario of random initializations on successive runs, there was nothing counter intuitive that was predominantly observed. SGD with momentum consistently outperformed adam in almost every different parametric scenario.

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Number equations consecutively. To make your equations more compact, you may use the solidus (/), the exp function, or appropriate exponents. Italicize Roman symbols for quantities and variables, but not Greek symbols. Use a long dash rather than a hyphen for a minus sign. Punctuate equations with commas or periods when they are part of a sentence, as in:

$$a + b = \gamma \quad (1)$$

Be sure that the symbols in your equation have been defined before or immediately following the equation. Use “(1)”, not “Eq. (1)” or “equation (1)”, except at the beginning of a sentence: “Equation (1) is . . .”

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- In your paper title, if the words “that uses” can accurately replace the word “using”, capitalize the “u”; if not, keep using lower-cased.
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- The prefix “non” is not a word; it should be joined to the word it modifies, usually without a hyphen.
- There is no period after the “et” in the Latin abbreviation “et al.”.
- The abbreviation “i.e.” means “that is”, and the abbreviation “e.g.” means “for example”.

An excellent style manual for science writers is [7].

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a) *Positioning Figures and Tables:* Place figures and tables at the top and bottom of columns. Avoid placing them in the middle of columns. Large figures and tables may span across both columns. Figure captions should be below the figures; table heads should appear above the tables. Insert

TABLE I: Table Type Styles

Table Head	Table Column Head		
	Table column subhead	Subhead	Subhead
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^aSample of a Table footnote.



Fig. 3: Example of a figure caption.

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Figure Labels: Use 8 point Times New Roman for Figure labels. Use words rather than symbols or abbreviations when writing Figure axis labels to avoid confusing the reader. As an example, write the quantity “Magnetization”, or “Magnetization, M”, not just “M”. If including units in the label, present them within parentheses. Do not label axes only with units. In the example, write “Magnetization (A/m)” or “Magnetization {A[m(1)]}”, not just “A/m”. Do not label axes with a ratio of quantities and units. For example, write “Temperature (K)”, not “Temperature/K”.

ACKNOWLEDGMENT

The preferred spelling of the word “acknowledgment” in America is without an “e” after the “g”. Avoid the stilted expression “one of us (R. B. G.) thanks ...”. Instead, try “R. B. G. thanks...”. Put sponsor acknowledgments in the unnumbered footnote on the first page.

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Please number citations consecutively within brackets [1]. The sentence punctuation follows the bracket [2]. Refer simply to the reference number, as in [3]—do not use “Ref. [3]” or “reference [3]” except at the beginning of a sentence: “Reference [3] was the first ...”

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For papers published in translation journals, please give the English citation first, followed by the original foreign-language citation [6].

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