Machine Learning with the NVIDIA Jetson Platform

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1st Cox, Jason

The Governor's School for Science and Technology (of Aff.)
Hampton, United States
jason.cox@nhrec.org

2nd Chestnut, William

The Governor's School for Science and Technology
Hampton, United States
william.chestnut@nhrec.org

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I. Introduction

This document is a model and instructions for LATEX. Please observe the conference page limits.

II. LITERATURE REVIEW

A. Introduction

The NVIDIA Jetson is an embedded AI computing platform focussed on combining low-power with speed and accuracy. The embedded nature of devices like these allow for developments such as autonomous navigation, with Visual Simultaneous Localization and Mapping, or vision-based depth reconstruction on mobile platforms like exploration vehicles. These devices additionally make artificial intelligence more accessible to the common person. While not perfect, as this technology has much room for improvement, the Jetson allows for developers to create machine learning applications on a small scale without requiring a lot of power or cost, while still remaining effective and efficient. These developments have and will continue to have impacts in the fields of manufacturing, robotics, security, and customer experiences. This paper will review example cases of the use of the NVIDIA Jetson as well as go over analysis of the effectiveness of the device.

B. Overview of Machine Learning on NVIDIA Jetson

Designing hardware accelerators for neural networks or other machine learning applications involves a very precarious balance between constraints of low-power and high accuracy and throughput. (Mittal, 2019) The goal of the NVIDIA Jetson is to meet the above objectives and contribute to the developing interest in fields such as image processing, natural language processing, data analytics etc. The study from Halawa et al. characterizes the Jetson and concludes that the asymmetric

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nature of the CPU and GPU as well as the frequency balance point allow the developer to optimize performance while ensuring energy efficient computing. (Halawa et al., 2017) Making a device like the Jetson which can be so easily implemented into daily life encourages making artificial intelligence a part of the life of every person. The survey from Mittal explains numerous real-life implementations of the Jetson and highlights the goal of "AI for all".

C. SLAM Methods on Rovers with NVIDIA Jetson

Exploration vehicles such as those used on missions to Mars need accurate localization and autonomous navigation in order to be effective. (Giubilato et al., 2019) The first mission to Mars implemented wheel odometry, in which motion sensors were used to determine the robot's change in position, such as counting the number of wheel revolutions. However, due to rover wheels slipping in the sand, this method was highly inaccurate and a more effective way of measuring motion was required. This method was found in visual odometry, or more specifically, SLAM (Simultaneous Localization and Mapping). SLAM is essentially an application of machine learning in which the computer simultaneously builds a map and localizes a robot within it.

This technology is now being implemented via embedded computers such as the NVIDIA Jetson. The paper from Giubilato et al. reviewed the effectiveness and implementation of the Jetson on a ground rover using SLAM methods. Their evaluation showed the viability of the Jetson in this environment and provided a novel benchmark for visual SLAM algorithms on embedded computing platforms. The NVIDIA Jetson enables technologies like this and continues to make artificial intelligence more applicable and possible in real-world scenarios.

D. Vision-based Depth Reconstruction

Another example of the use of the NVIDIA Jetson is within vision-based depth reconstruction, a challenging problem that has been extensively studied in computer science. (Bokovoy et al., 2019) This technology deals with being able to judge depth from a single image. Sensors that can provide range

measurements are usually expensive, large, heavy, and power hungry. The study from Bokovoy et al. attempts to use the NVIDIA Jetson to solve these problems as it is inherently built to be the opposite of those qualifications. This analysis uses fully convolutional neural networks (FCNNs) in order to evaluate depth in real time using both a PC And the NVIDIA Jetson. They demonstrated that the models proposed were able to run effectively in real-time with state-of-the-art accuracy, once again establishing the Jetson as a viable way to easily and cheaply use artificial intelligence to solve problems in growing fields of mobile robotics, augmented reality, computer aided design etc.

E. Stereo Visual Implementation on NVIDIA Jetson

Embedded computing platforms have also demonstrated their place in real-time stereo vision systems. Stereo based 3-dimensional construction of a scene from an image has been studied in the past but most of these algorithms have extreme execution times, even on the most powerful computers. (Cui Dahnoun, 2019) The paper from Cui and Dahnoun demonstrates that a high power consumption processor would not work for autonomous applications of stereo vision, however, they show how an NVIDIA Jetson can be used to reduce computation cost and improve output quality. With their implementation, the paper concludes that the Jetson can reach performance faster than real-time requirements. The Jetson fills the gap of a low-power, low-cost, lightweight, and fast processor that can solve problems from location mapping, to depth measurement and 3D reconstruction.

F. Conclusion

These examples of implementations of the NVIDIA Jetson provide approaches to different problems that all revolve around a common necessity. A device that can be low-power and cost but highly effective. Embedded AI platforms make machine learning and artificial intelligence accessible in more fields of everyday life and having a device that can be used so flexibly expands the possibilities in AI.

III. PREPARE YOUR PAPER BEFORE STYLING

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B. Units

- Use either SI (MKS) or CGS as primary units. (SI units are encouraged.) English units may be used as secondary units (in parentheses). An exception would be the use of English units as identifiers in trade, such as "3.5-inch disk drive".
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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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E. Some Common Mistakes

- The word "data" is plural, not singular.
- The subscript for the permeability of vacuum μ_0 , and other common scientific constants, is zero with subscript formatting, not a lowercase letter "o".
- In American English, commas, semicolons, periods, question and exclamation marks are located within quotation marks only when a complete thought or name is cited, such as a title or full quotation. When quotation marks are used, instead of a bold or italic typeface, to highlight a word or phrase, punctuation should appear outside of the quotation marks. A parenthetical phrase or statement at the end of a sentence is punctuated outside of the closing parenthesis (like this). (A parenthetical sentence is punctuated within the parentheses.)
- A graph within a graph is an "inset", not an "insert". The word alternatively is preferred to the word "alternately" (unless you really mean something that alternates).
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- Be aware of the different meanings of the homophones "affect" and "effect", "complement" and "compliment", "discreet" and "discrete", "principal" and "principle".
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- The prefix "non" is not a word; it should be joined to the word it modifies, usually without a hyphen.
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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 figures and tables after they are cited in the text. Use the abbreviation "Fig. 1", even at the beginning of a sentence.

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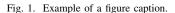


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ACKNOWLEDGMENT

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

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