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Study of Pann Components in Image Treatment for Medical Diagnostic Decision-Making

Estudo de Componentes Pann no Tratamento de Imagem para Tomada de Decisão de Diagnóstico Médico

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ABSTRACT

The hospital branch has benefited from offering activities that use collections of imaging tests for specialists to use for decision-making in conjunction with other clinical examinations. It is intended to study pathologies resulting from cancer cells. In this article, there is the possibility of presenting Artificial Intelligence solutions to support specialists. For this, the objective is to use the concepts of Paraconsistent Logic and Artificial Intelligence applied in Artificial Neural Networks and to propose the use of components of Paraconsistent Artificial Neural Networks (PANN) to support specialists in decision-making.

Keywords: Artificial Paraconsistent Neurons. Artificial Intelligence. Paraconsistent Logic. Deep Learning Paraconsistent.

RESUMO

O setor hospitalar se beneficiou de oferecer atividades que utilizam coleções de testes de imagem para que os especialistas possam usar para tomar decisões em conjunto com outros exames clínicos. O objetivo é estudar patologias resultantes de células cancerígenas. Neste artigo, há a possibilidade de apresentar soluções de Inteligência Artificial para apoiar os especialistas. Para isso, o objetivo é utilizar os conceitos de Lógica Paraconsistente e Inteligência Artificial aplicados em Redes Neurais Artificiais e propor o uso de componentes de Redes Neurais Artificiais Paraconsistentes (PANN) para apoiar os especialistas na tomada de decisões.

Palavras-chave: Neurônios Artificiais Paraconsistentes. Inteligência Artificial. Lógica Paraconsistente. Deep Learning Paraconsistente.

1 INTRODUCTION

Research related to AI started after the Second World War and the first work in this area was carried out by Alan Turing (RUSSELL & NORVIG, 2010), since then much research has been carried out. Defining the concept of artificial intelligence is very difficult. For this reason, Artificial Intelligence was and remains, a notion that has multiple interpretations, often conflicting or circular.

The difficulty of a clear definition may come from the fact that there are several human faculties that are being reproduced, from the ability to play chess, or involved in areas such as computer vision, voice analysis, and synthesis, fuzzy logic, artificial neural networks, and many others. Initially, AI aimed to reproduce human thought. Artificial Intelligence embraced the idea of reproducing human faculties such as creativity, self-improvement, and the use of language. Artificial Neural Networks.

Section headings should be left justified, bold, with the first letter capitalized and numbered consecutively, starting with the Introduction. Sub-section headings should be in capital and lower-case italic letters, numbered 1.1, 1.2, etc., and left justified, with second and subsequent lines indented. All headings should have a minimum of three text lines Footnotes.

Warren McCulloch and Walter Pitts created a computational model for neural networks based on mathematics and algorithms called threshold logic. This model paved the way for research on the neural network divided into two approaches: one approach focused on biological processes in the brain, while the other focused on the application of neural networks to artificial intelligence.

The notion of a network of neurons begins its first steps in 1949, Donald Hebb wrote The Organization of Behavior, a work that pointed to the fact that neural pathways are strengthened each time they are used, a concept fundamentally essential to the way how humans learn. If two nerves fire at the same time, he argued, the connection between them is improved.

In 1958, Frank Rosenblatt created Perceptron (MYCIELSKI, 1972), an algorithm for pattern recognition based on a two-layer computational neural network using simple addition and subtraction. He also proposed additional layers with mathematical notations, but that would not be done until 1975.

In 1959, Bernard Widrow and Marcian Hoff, from Stanford, developed models called “ADALINE” and “MADALINE”. That was the first neural network applied to a real problem.

Ness Recurrent Neural Network - RNN network architecture: The hidden neurons of the recurrent neural network receive the result of the mathematical operation that they performed in the previous time in addition to the data from the previous layer. Thus, the RNNs consider a temporal dependency between the input data. Because they have this characteristic, these networks can model problems with temporal characteristics, such as the weather forecast given the climate history in a window of the past.

The Convolutional Neural Network – CNN, or Deep Convolutional Network – DCN, or simply convolutional neural network has a very different structure from those presented so far. In the convolution layers, the information passes through several filters, which in practice are numeric matrices, with the function of accentuating regular local patterns, while reducing the size of the original data. The results of various filters are summarized by pooling operations. In the deepest part of the convolutions, data in a reduced dimensional space is expected to contain enough information about these local patterns to assign a semantic value to the original data. These data then go through a classic FFN structure for the classification task. For these characteristics, the most common application of CNNs is in the classification of images; the filters accentuate the attributes of the objects necessary for their correct classification. A CNN specialized in classifying faces, for example, in the first layers recognizes contours, curves, and borders; further on, it uses this information to recognize mouth, eyes, ear, and nose; and in the end, it recognizes the entire face. In addition to images, any information with local regularity can benefit from the use of CNNs, such as audio for example.

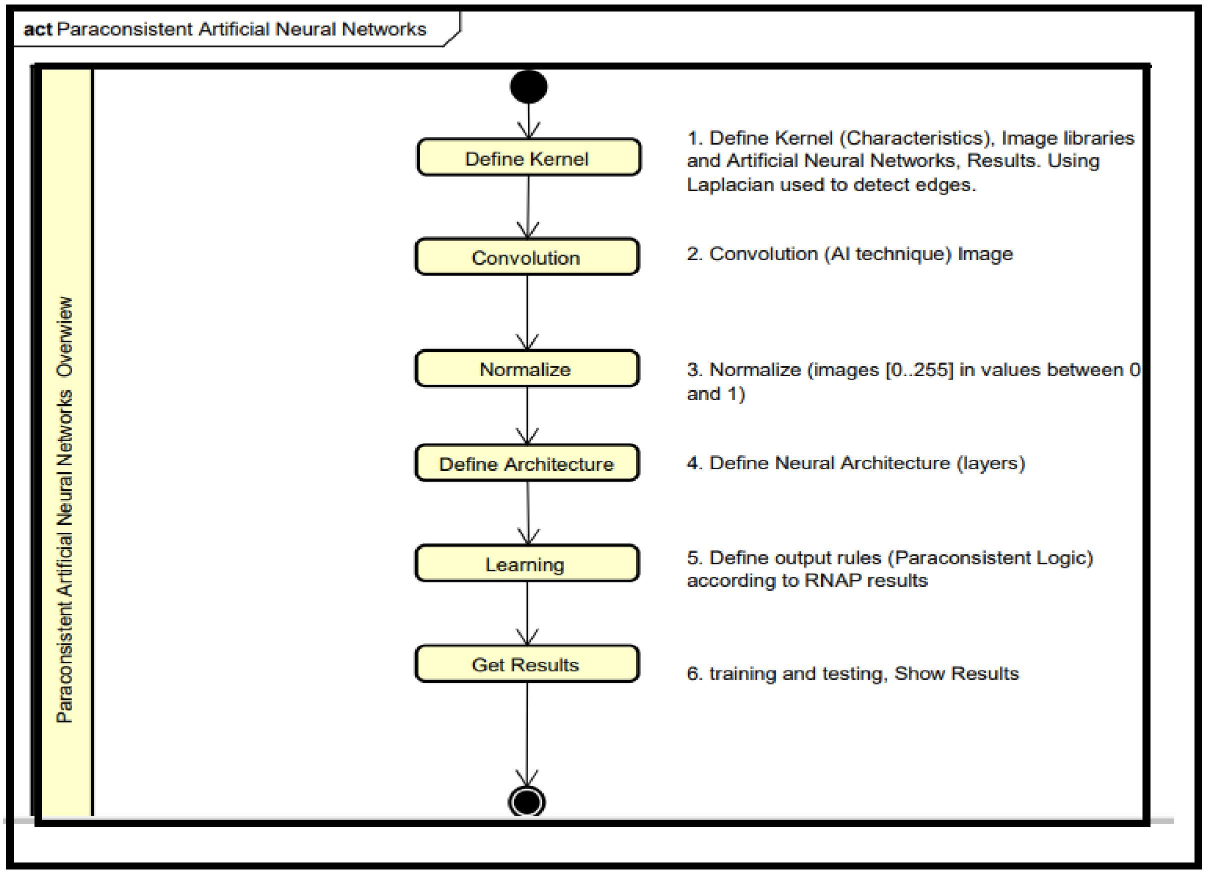
A Paraconsistent (ABE et al., 2011). Deep Learning Network – DLP, also known as a Deep Artificial Neural Network – DANN, where the artificial neurons are Paraconsistent Artificial Neurons – PAN. NAPs are constructed with Paraconsistent Neural Units (FILHO, ABE & TORRES, 2008) from different families.

The studies on Artificial Neural Networks, Network Components, and Paraconsistent Logic (AKAMA, ABE & NAKAMATSU, 2015), culminated in the creation of the flowchart (fig. 1) to materialize the unification of concepts. So, we must use the sequence that starts in the definition of the “1- Nucleus” which corresponds to the extraction of the characteristics in the specific case of images, the “Laplacian” type was used with a focus on edge detection.

Then, the “2- convolution” (ZHANG, ZHAO & LECUN, 2015). is done specifically in the treatment of images (BULTEN et al., 2019) because it was used as a model of feature detectors (lines, edges). Now “3-normalization” is applied to standardize all inputs (text and images) in the artificial neural network, which would be to transform all inputs in intervals between 0 and 1 to guarantee performance.

According to the completion of the stage in the treatment of data (text and images), a neural "4-architecture" (quantity of layers and neurons) is defined according to the complexity and available computational capacity.

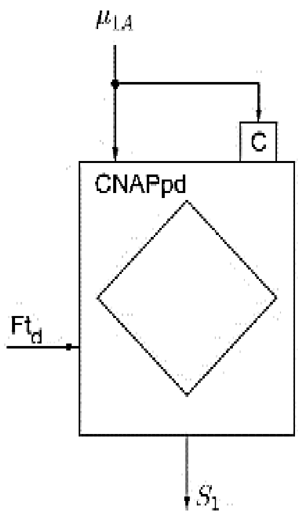
Figure 1 – Paraconsistent Artificial Neural Networks Overview



At this point, the study was guided by proposing the use of paraconsistent logic, and thus were defined, which are rules for obtaining plausible results. And finally, "5- learning" during training by the artificial neural network and "6- display" the results for analysis.

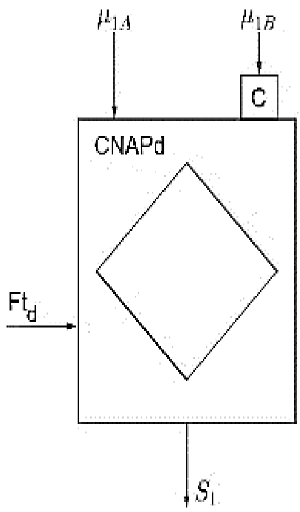
The base of the CNAPp component (fig.5) was fundamental for the creation of the other components that consolidate the paraconsistent family: CNAPpd (fig. 2), CNAPd (fig. 3), CNAPco (fig. 4).

Figure 2 – Paraconsistent Artificial Neural Component of Passage and Decision - CNAPpd



This component analyzes the input evidence and outputs two possible V or Undefined results (1.0.5).

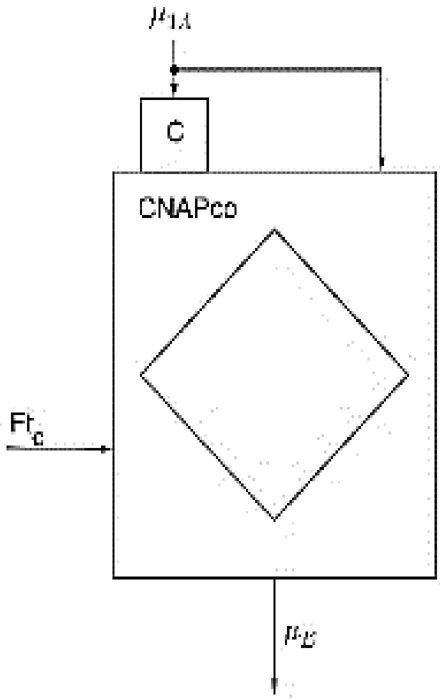
Figure 3 – Paraconsistent Artificial Neural Component of Decision - CNAPd



This component analyzes the input evidence and outputs three possible results V, F, or Undefined (1,

0,0.5).

Figure 4 – Paraconsistent Artificial Neural Component for Complementation – CNAPco



This component has the function of complementing the favorable evidence, having the limits controlled by the tolerance factor.

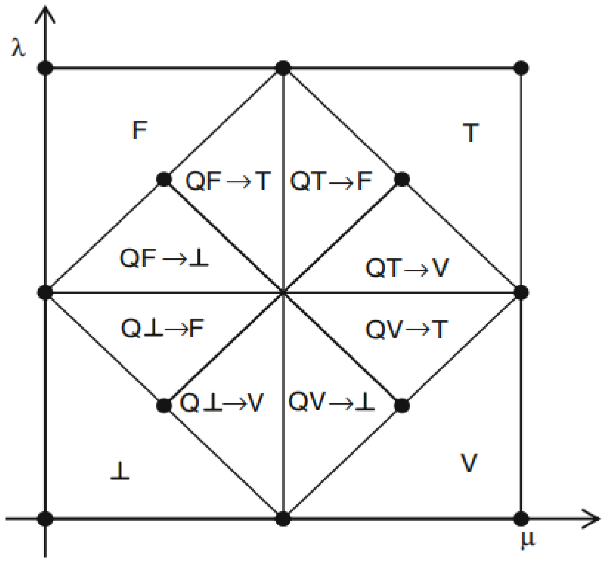
In the advancement of researches an artificial neural network, it is understood that they can be added to the concepts of paraconsistent logic, providing the viability shown in the flowchart (fig. 1) and with a great capacity to be applied in the systemic precepts with computational algorithms in their particularity in the components basic, learning and decision-making (CARVALHO & ABE, 2018), as it is possible to obtain the extraction of characteristics in the data made available both in historical bases and in real-time that can be proposed by viewing patterns to support specialists (BALANCIN, 2020) in their decision-making.

2 METHODOLOGY

Initially, a bibliographic review was carried out in Artificial Intelligence, Deep Learning (WANG et al., 2018). focused on the application in logistics centers, followed by a research of the Paraconsistent Annotated Logic Eτ for application Artificial Intelligence. From this proposal, the programming of the Artificial Intelligence Python language was elaborated with the concepts of Paraconsistent Evidential Logic Eτ, through the paraconsistent algorithm, which will play a fundamental role in decision-making assistance (AKAMA, ABE

& NAKAMATSU, 2015). For the beginning of the development of the paraconsistent algorithm, the reticulate (fig. 5) was used as a reference (ABE et al., 2011).

Figure 5 – Aspect of the Lattice to make decision (ABE et al., 2011)



3 DISCUSSION

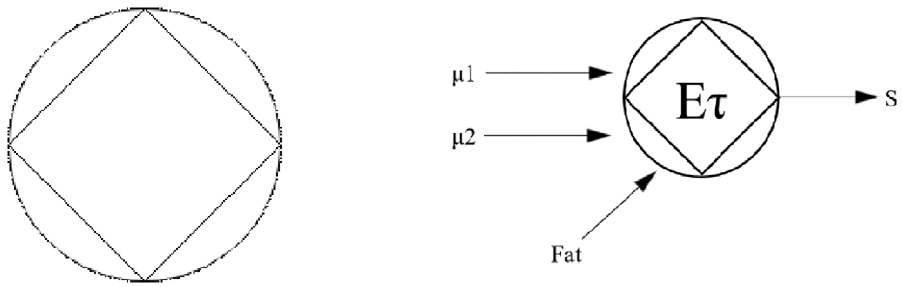
In the advancement of researches an artificial neural network, it is understood that they can be added to the concepts of paraconsistent logic, providing the viability shown in the flowchart (fig. 1) and with a great capacity to be applied in the systemic precepts with computational algorithms in their particularity in the components basic, learning (SIMONE, 2018) and decision-making, as it is possible to obtain the extraction of characteristics in the data made available both in historical bases and in real-time that can be proposed by viewing patterns to support specialists in their decision-making.

The paraconsistent analyzer unit should reflect a set of artificial paraconsistent neurons capable of serving a particular purpose. In general, the paraconsistent artificial neuron can contain at least four possible outputs: False, True Inconsistent, and Paracomplete.

Next, we propose the neuron (fig. 6) with inputs (μ1, μ2), adjustment factors and limits (Fat), and possible outputs (S). This with the possibility of meeting extreme and non-extreme states.

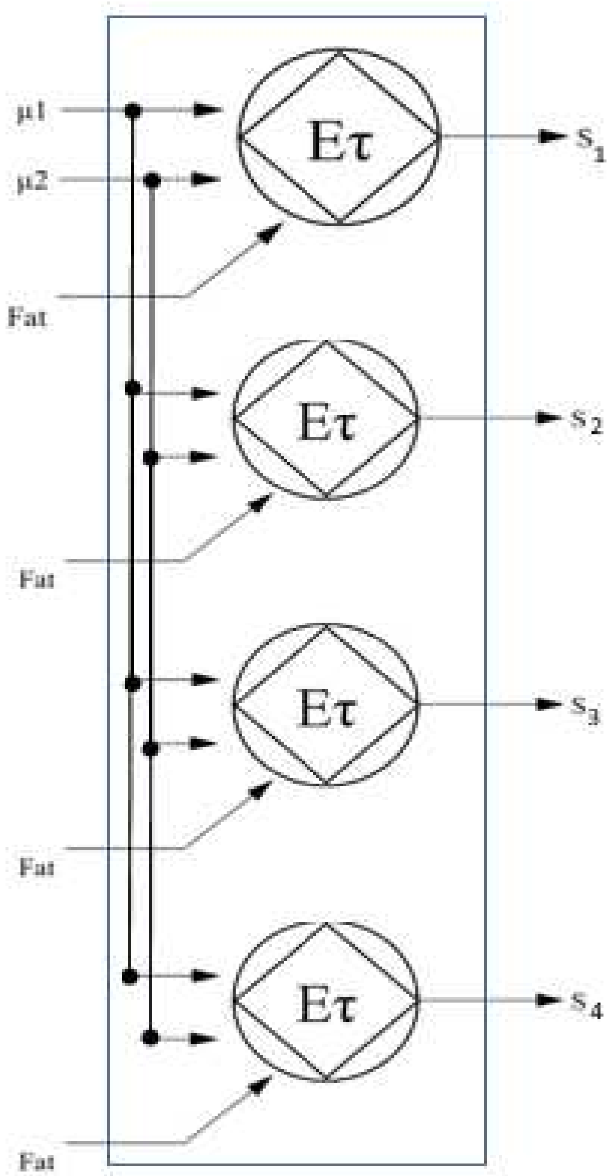
Figure 6 – (a) Paraconsistent Neuron Symbol; (b) Artificial Paraconsistent Neurons

a b



Currently, the family of units is widely disseminated by preliminary studies and stands out as memory units or as pattern sensors in primary layers. We have, for example, the Basic Paraconsistent Artificial Neural Cell - CNAPba, Paraconsistent Artificial Neural Cell of learning – CNAPa (fig. 8), it has the function of learning and unlearning patterns that are repeatedly applied at its entrance. And the Paraconsistent Artificial Neural Cell for decision - CNAPd, has the function of making the paraconsistent analysis and determining a decision based on the results of the analysis. This makes possible the appearance of several new units such as the proposed design of the Paraconsistent Artificial Neural Unit - UNAP2.0 (fig. 7). This has the function of meeting extreme and non-extreme states.

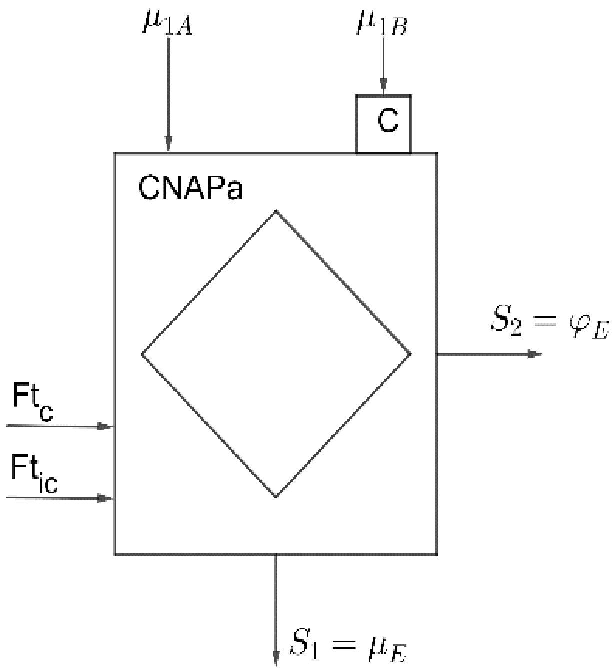
Figure 7 – Paraconsistent Artificial Neural Unit - UNAP2.0



In the Paraconsistent Artificial Neural Unit - UNAP2.0, it stands out for allowing the treatment of extreme and non-extreme states (fig. 5). Thus, the analysis and support to the specialist can be adjusted to plausible levels during the analysis.

The Paraconsistent Artificial Neural component standard – CNAPp performs the paraconsistent analysis through the following algorithm para-analyzer (fig. 9).

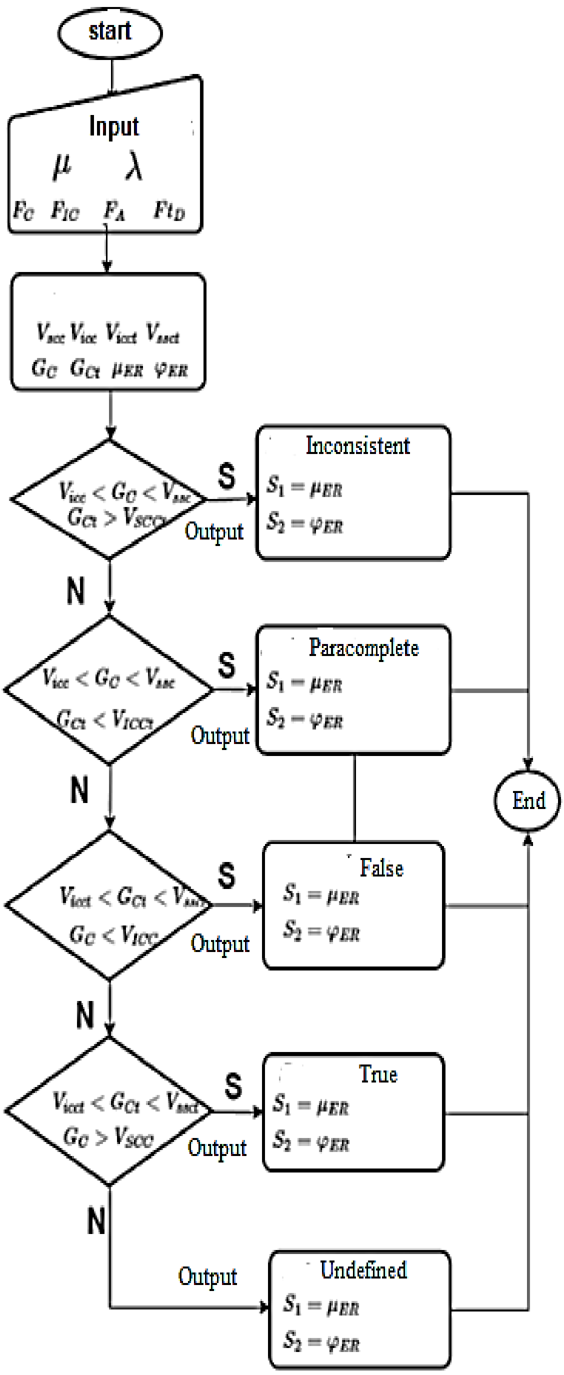
Figure 8 – Artificial Intelligence



Source: (FILHO; ABE & TORRES, 2008)

The para-analyzer algorithm (fig. 9) allows the application of paraconsistent logic and was represented in modeling language to elucidate the understanding when materialized in the computational application.

Figure 9 – Flowchart para-analyzer algorithm



Source: adapted from (FILHO; ABE & TORRES, 2008)

4 CONCLUSION

The set of images provide a better understanding in the analyzes and that involve specialists. In view of this motivation, it was proposed to unify the techniques of neural networks and paraconsistent logic that culminated in the creation of basic steps (fig. 1) to apply artificial paraconsistent neural networks - PANN. Thus, the construction of the paraconsistent artificial neuron (fig. 8) proved feasible, for the creation of a Paraconsistent Artificial Neural Network - PANN, in a computer system capable of handling response through the network and using Paraconsistent Logic supporting specialists in decision-making.

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