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Review Article

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AI Flashcard: Applied Biomedical Engineering Using Artificial Intelligence and Cognitive Models

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Book Thesis Statement

The book "Applied Biomedical Engineering Using Artificial Intelligence and Cognitive Models" is focused on facilitating engineering students of various specialties, and researchers to integrate *"Artificial Intelligence (AI)"* different tools from *"Machine Learning (ML)", "Deep Learning (DL)" and Cognitive Learning (CC)"*. In the development of new solutions for human health using already digested "Mathematical AI Models and AI algorithms" that will help them make medical evaluation decisions in many types of injuries, illnesses, diseases, especially neurological diseases.

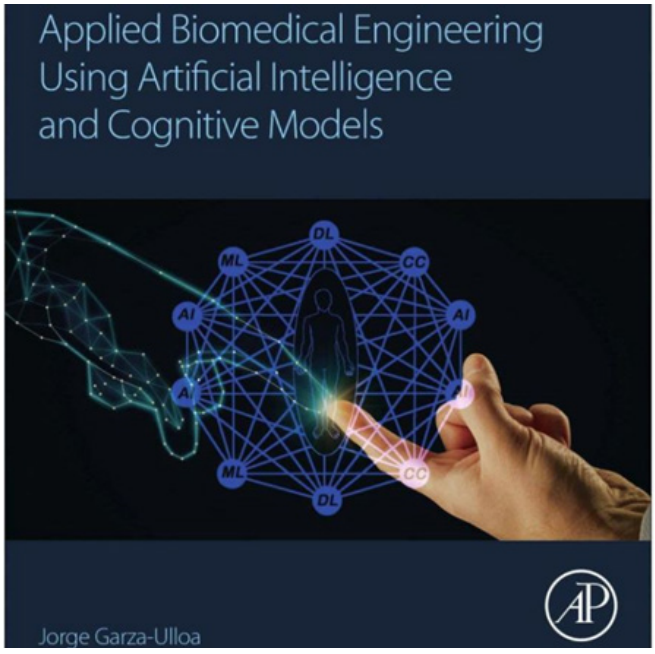

Figure 1: The book Applied Biomedical Engineering Using Artificial Intelligence and Cognitive Models focuses on the relationship between three different multidisciplinary branches of engineering: Biomedical Engineering, Cognitive Science and Computer Science through Artificial Intelligence models.

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Readership

Reference for Academic research on: Biomedical Engineering, Biomechatronics, Applied Informatics, Bioinformatics, Biomechanics, Neural Engineering, Clinical Engineering, Rehabilitation Engineering, Applied Mathematics, computational intelligence, Medical devices and many others, besides specific practical applications in Human computer interaction, cognitive robotics, cognitive ergonomics and cognitive engineering.

Main Goal

Students and researchers enhance their knowledge using mathematics and artificial intelligence, plus the human factor, which will open many minds to improve people's health developing their own goals.

Focus

The book *"Applied Biomedical Engineering Using Artificial Intelligence and Cognitive Models"* focuses on the relationship between three different multidisciplinary branches of engineering: Biomedical Engineering, Cognitive Science and Computer Science through Artificial Intelligence models. These models will be used to study how the nervous system and musculoskeletal system obey movement orders from the brain, as well as the mental processes of the information during cognition when injuries illness and disease are present in the human body.

Book Examples as AI Flashcards

Some examples as an **AI Flashcards** of my book from Academic Press - Elsevier, *"Applied Biomedical Engineering Using Artificial Intelligence and Cognitive Models"*. The goal of this book is Analyze and Modeling Non-motor symptoms form diseases, injuries, and diseases with Artificial Intelligence (AI), Machine Learning (ML), Deep Learning (DL) and Cognitive Learning (CC).

Example: 1

a. Mammograms Classify Mammograms standard views types from Low doses x-rays.

b. Object detection abnormalities of breast tumor in mammogram Low doses x-rays.

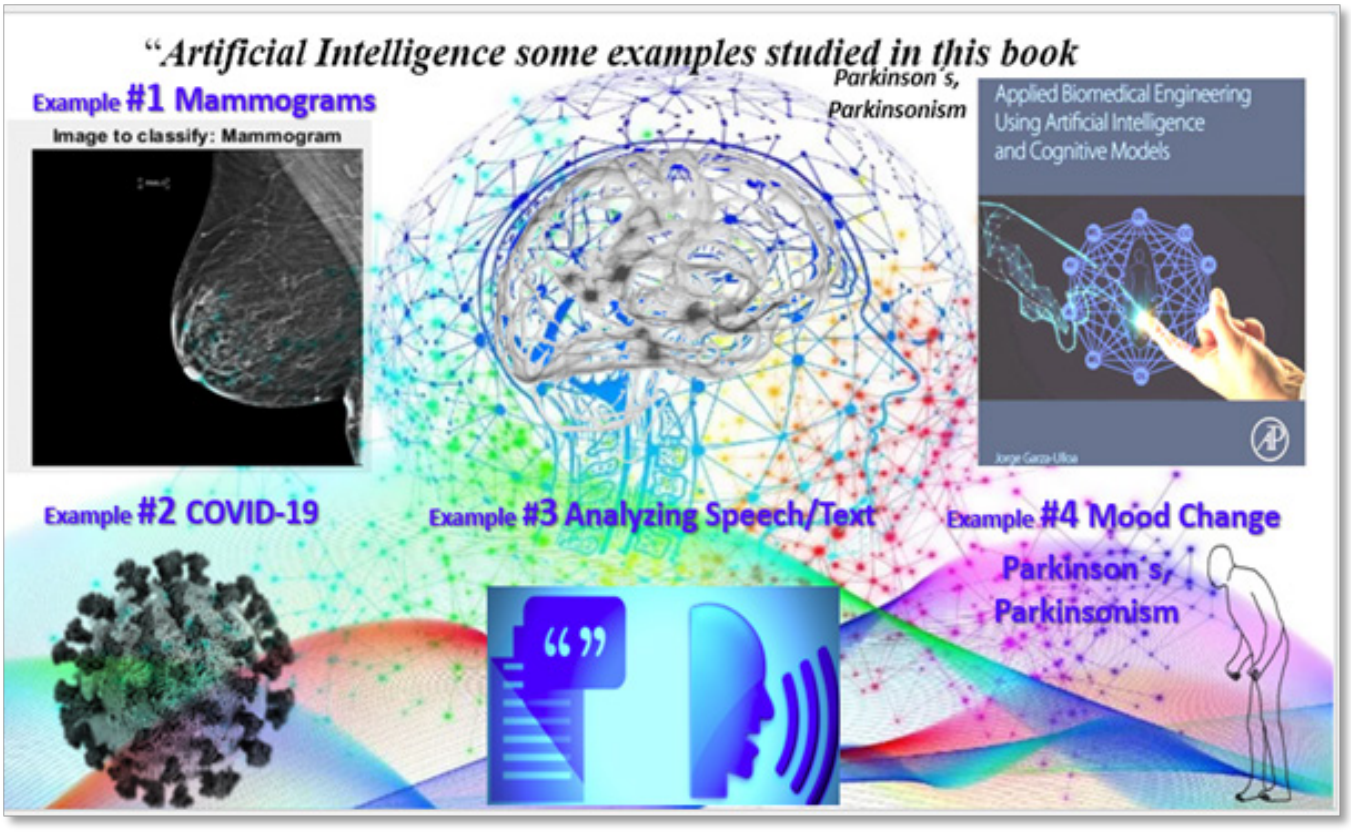

Figure 2: Four examples as *AI Flashcards* of many Artificial Intelligence studied in this book to analyze: Mammograms, COVID-19, Speech/Tech and Mood change in Parkinson.

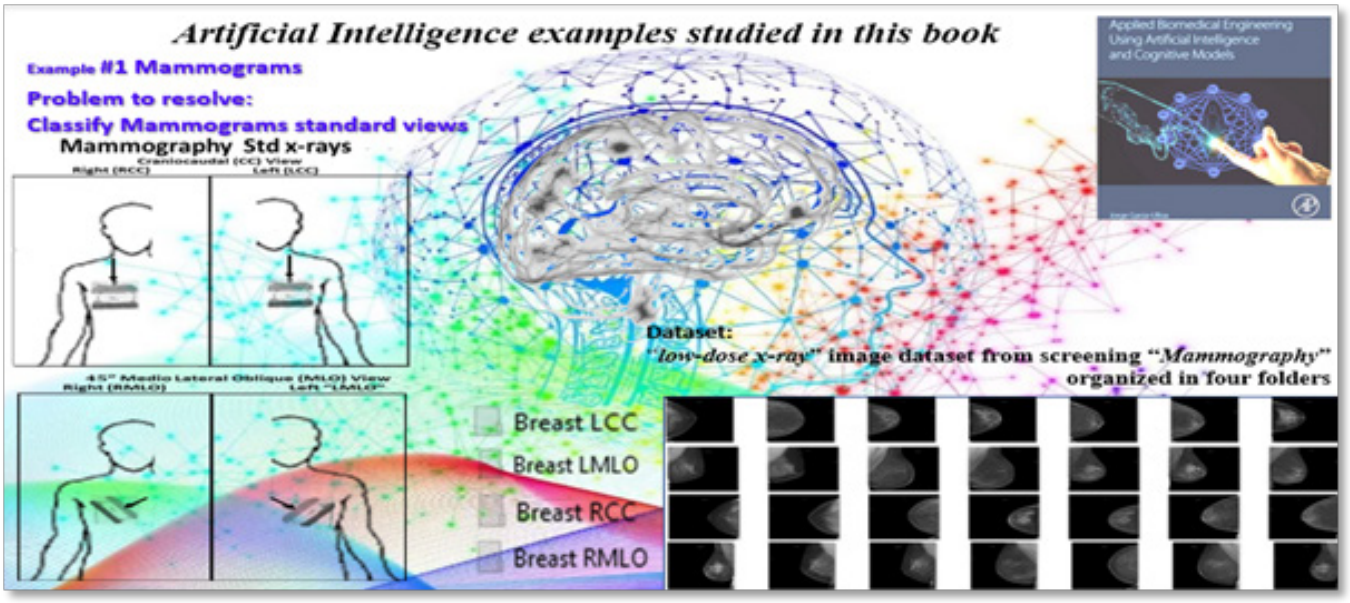

Figure 3: AI Flashcard Problem to resolve: Classify Mammograms standard views types from Low doses x-rays (left), and low-dose x-ray" image dataset from screening "Mammography" organized in four folders.

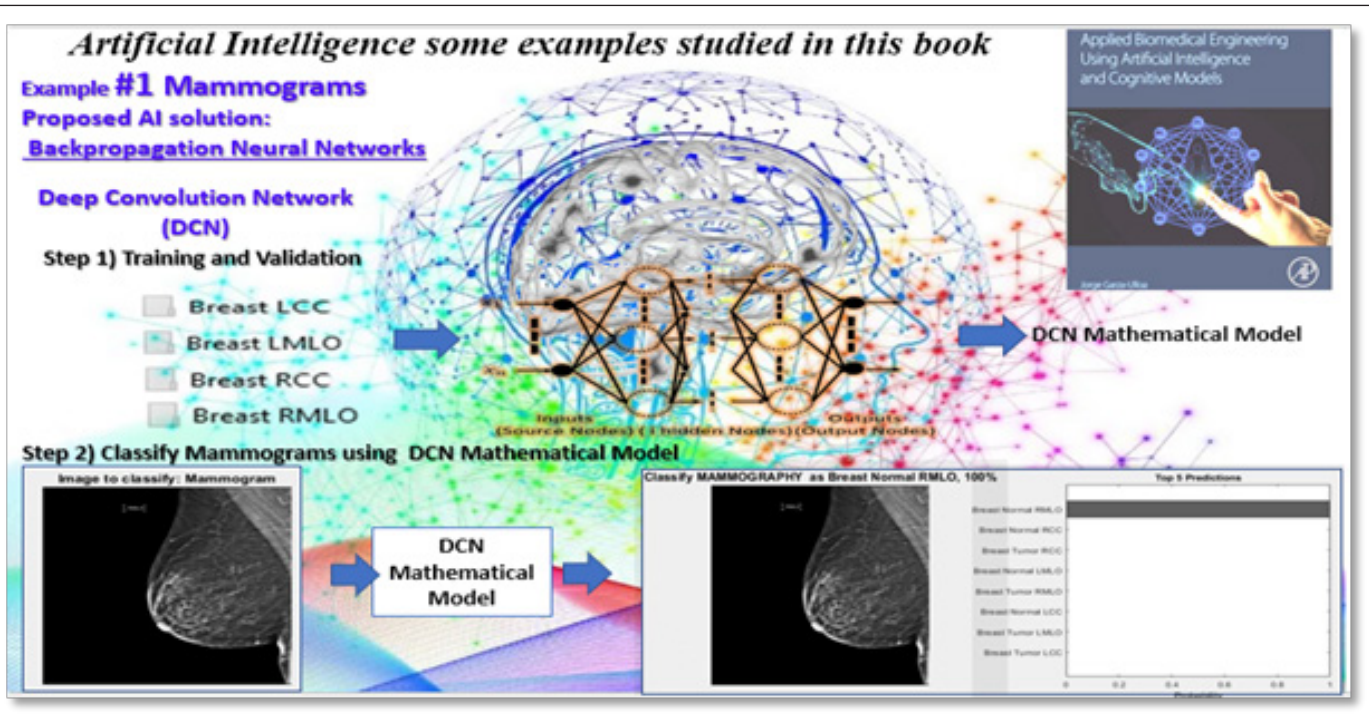

Figure 4: Flashcard Proposed AI solution for Backpropagation Neural Networks applying Deep Convolution Network (DCN). Step 1) Input are the 4 folders of different types to the DCN to obtain a DCN Mathematical Model form the training images (middle), then Step 2) An input of any type is analyzed for the "DCN Mathematical Model", and the output recognize the type (Bottom).

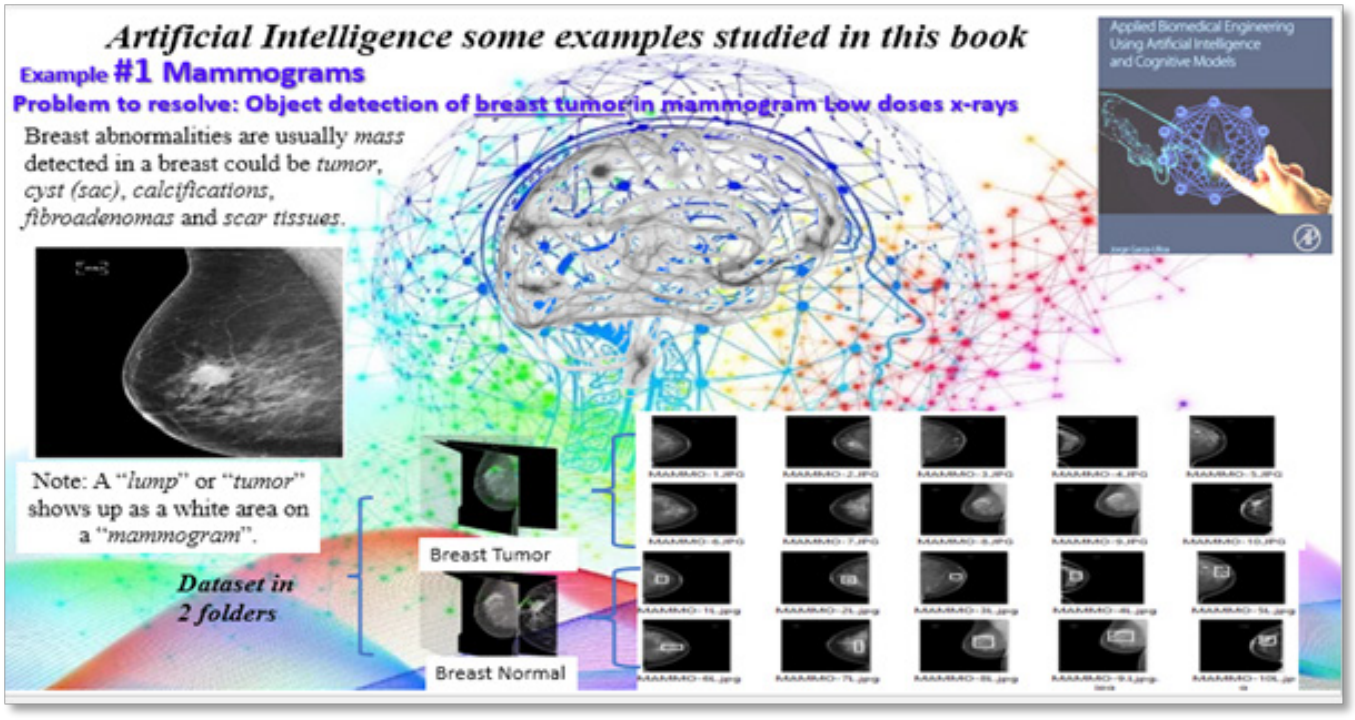

Figure 5: AI Flashcard Problem to resolve: Object detection of breast tumor in mammogram Low doses x-rays as breast abnormalities as tumor, cyst, calcifications, fibroadenomas and scar tissues (Top left), the dataset consists of two folders: Breast Tumor and Breast Normal.

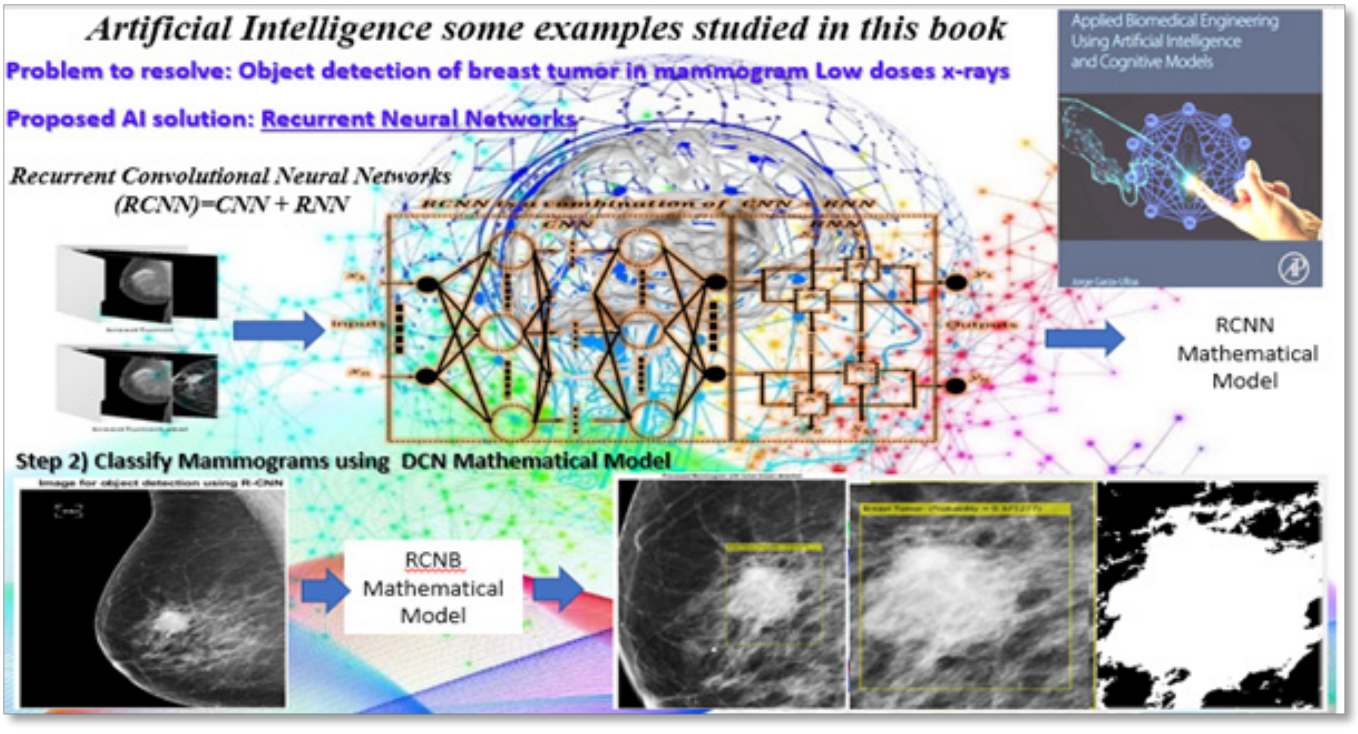

Figure 6: AI Flashcard proposed AI solution: Recurrent Convolutional Neural Networks, the first step shows the Input of two folders ": Breast Tumor and Breast Norma" to a RCNN and the output of the training is a "RCNN Mathematical Model". The second step is to input any breast model with breast abnormalities to the "RCNN Mathematical Model", the output indicated the breast abnormality detected.

Example: 2

a. Simulation "SARS-CoV-2 9 COVID-19) respiratory transmission in a room 2 x 2 x 2 mts.

b. Differentiate between Normal and Pneumonia on x-rays.

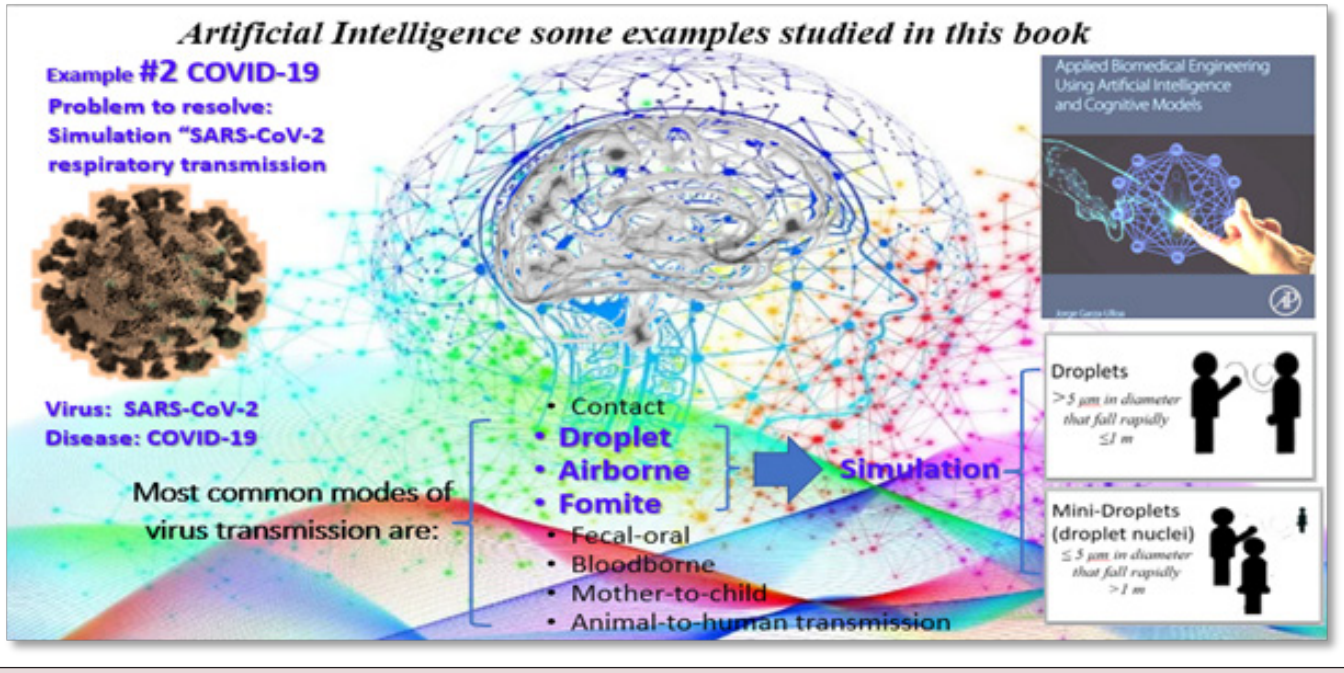

Figure 7: AI Flashcard problem to resolve: Simulation "SARS-CoV-2" respiratory transmission with focus on Droplet (fall rapidly<= 1 mt) and Mini-Droplet (stay longer dispersing and floating on a room fall > 1 mts).

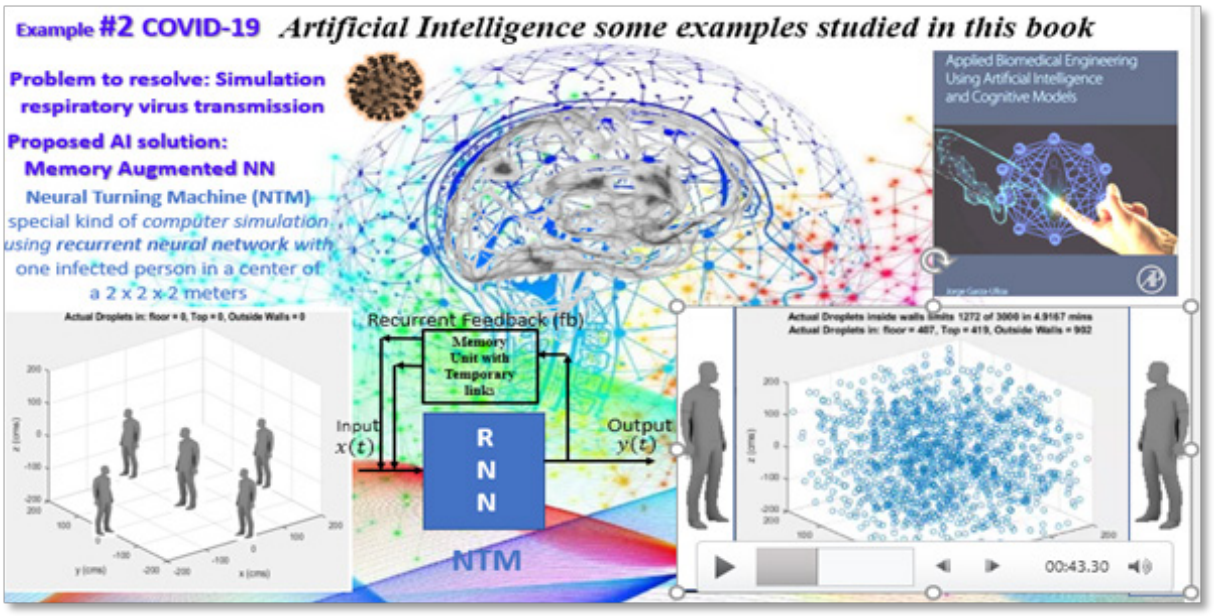

Figure 8: AI Flashcard proposed AI solution based on Memory Augmented NN known as Neural Turning Machine (NTM) special kind of computer simulation using recurrent neural network with one infected person in a center of a 2 x 2 x 2 meters (bottom left side), and dispersion result after approx. 5 min. (bottom right-side video on: *https://youtu.be/3OPKtTyrt4g*)

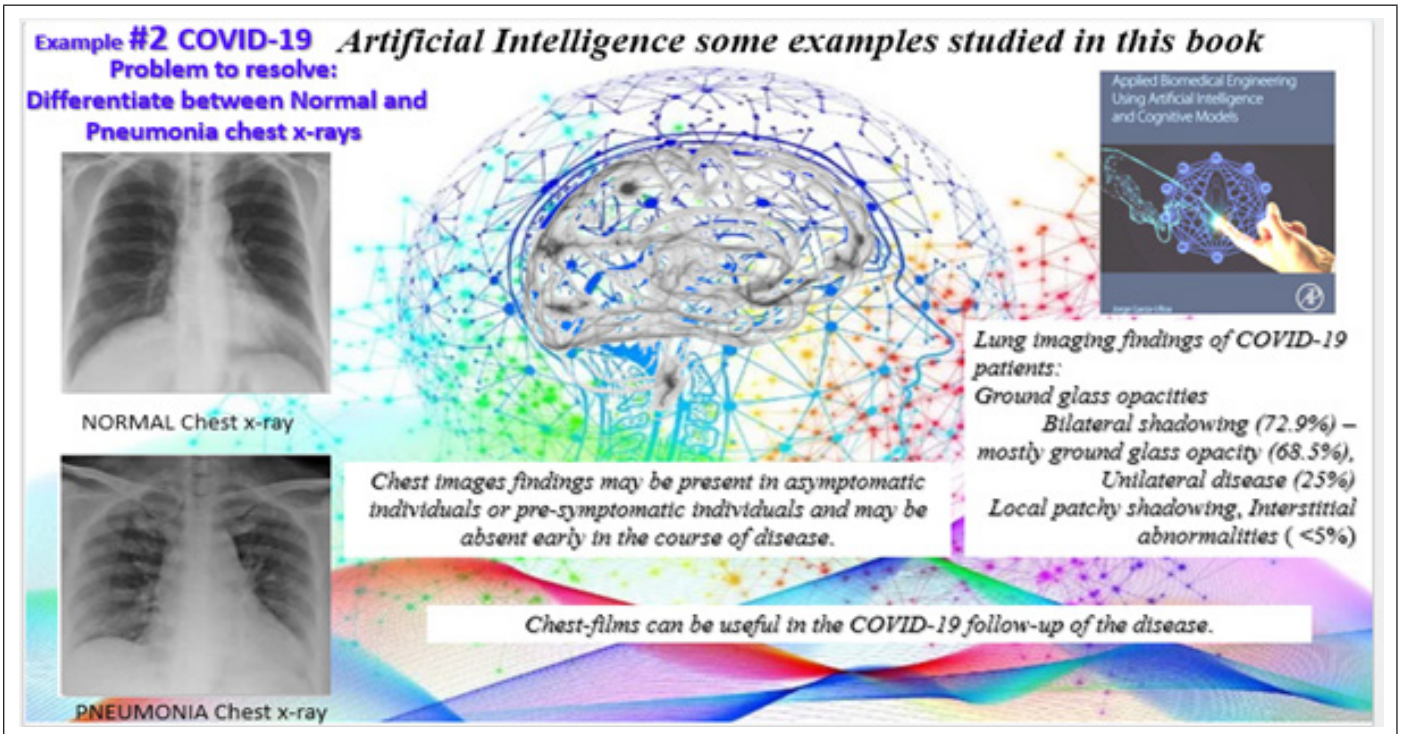

Figure 9: AI Flashcard problem to resolve: Differentiate between Normal and Pneumonia chest x-rays, Chest-films can be useful in the COVID-19 follow-up of the disease. A normal Chest x-ray (left top) and a Pneumonia Chest x-ray (left bottom) are shown an AI solution is needed to differentiate between them.

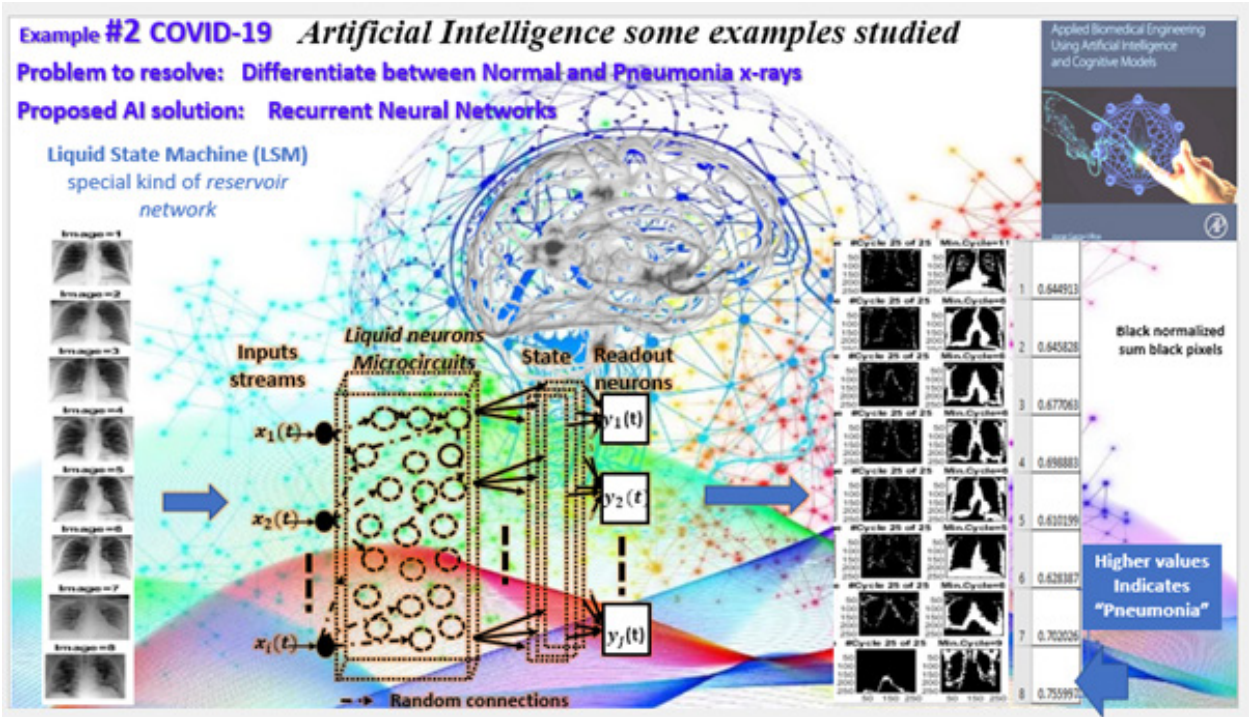

Figure 10: AI Flashcard problem to resolve: Differentiate between Normal and Pneumonia x-rays, Proposed AI solution with a Recurrent Neural Network (RNN) as a Liquid State Machine (LSM). The input is a group of x-rays taken in consecutive day of a COVID-19 patient to be analyze for a Liquid State Machine (LSM) structure and the output shows the evaluating theme with a number that is increasing, where higher values mean more lung damage.

Example: 3

a. Detect the most important themes of speech or text in a conversation applying Natural Language. Processing (NLP) - K-Nearest Neighbor (KNN) .

Example: 4

a. Analyze mood changes in neurologic diseases applying Support Vector Machine (SVM).

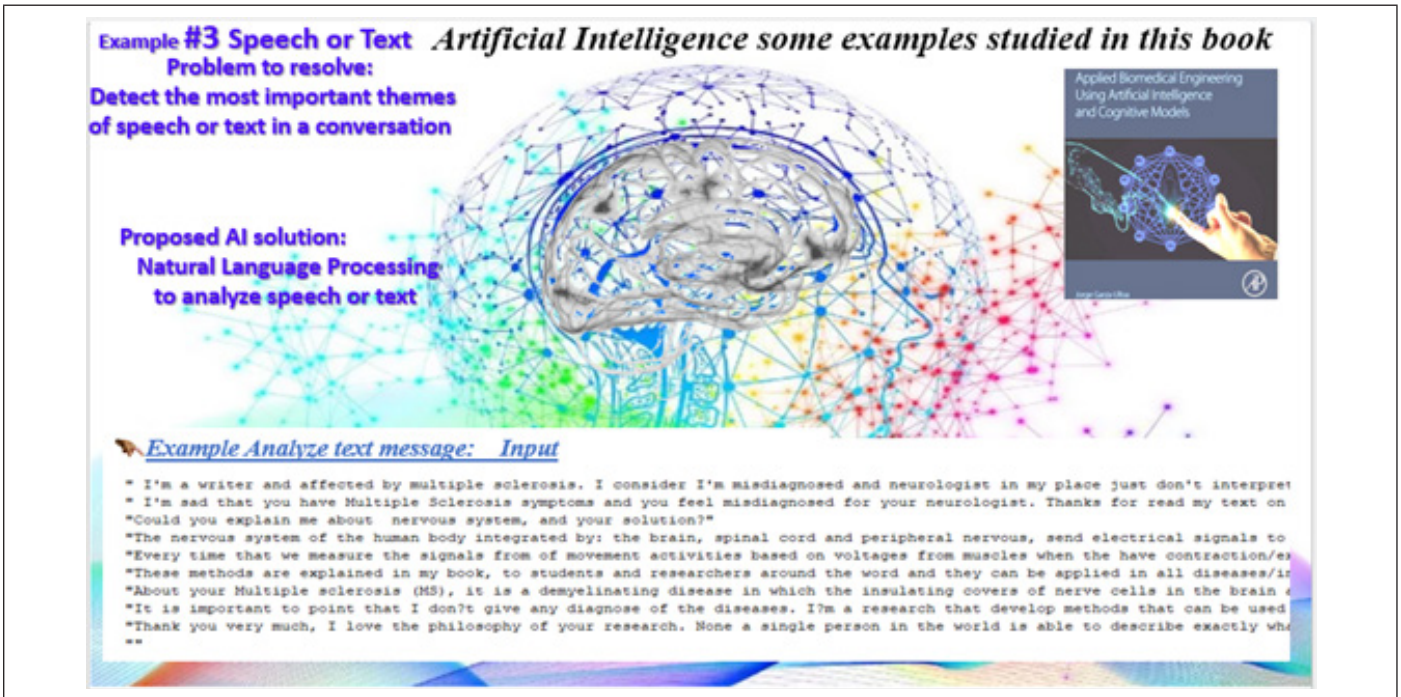

Figure 11: AI Flashcard problem to resolve: Detect the most important themes of a speech or text in a conversation, Proposed AI solution: "Natural Language Processing (NLP)" as an example a group of email as shown at the bottom.

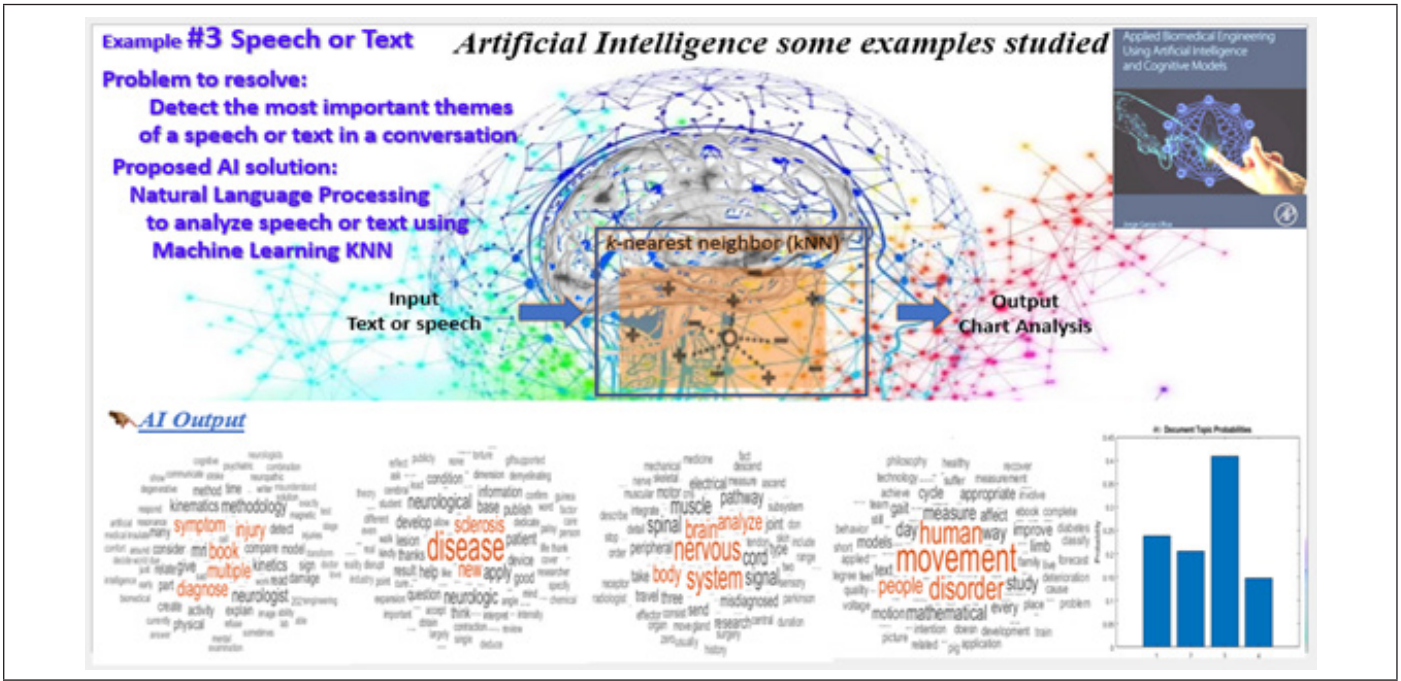

Figure 12: AI Flashcard Natural Language Processing (NLP) to analyze speech or text with a Machine Learning (ML) algorithm applying K-nearest neighbor (KNN). The input is feed with the email to a KNN model to obtain as an output the main for categories and bar chart indicating that the 3rd category is the most important "analyze the body nervous system", 1st "with multiple symptoms" 2nd For "her multiple sclerosis".

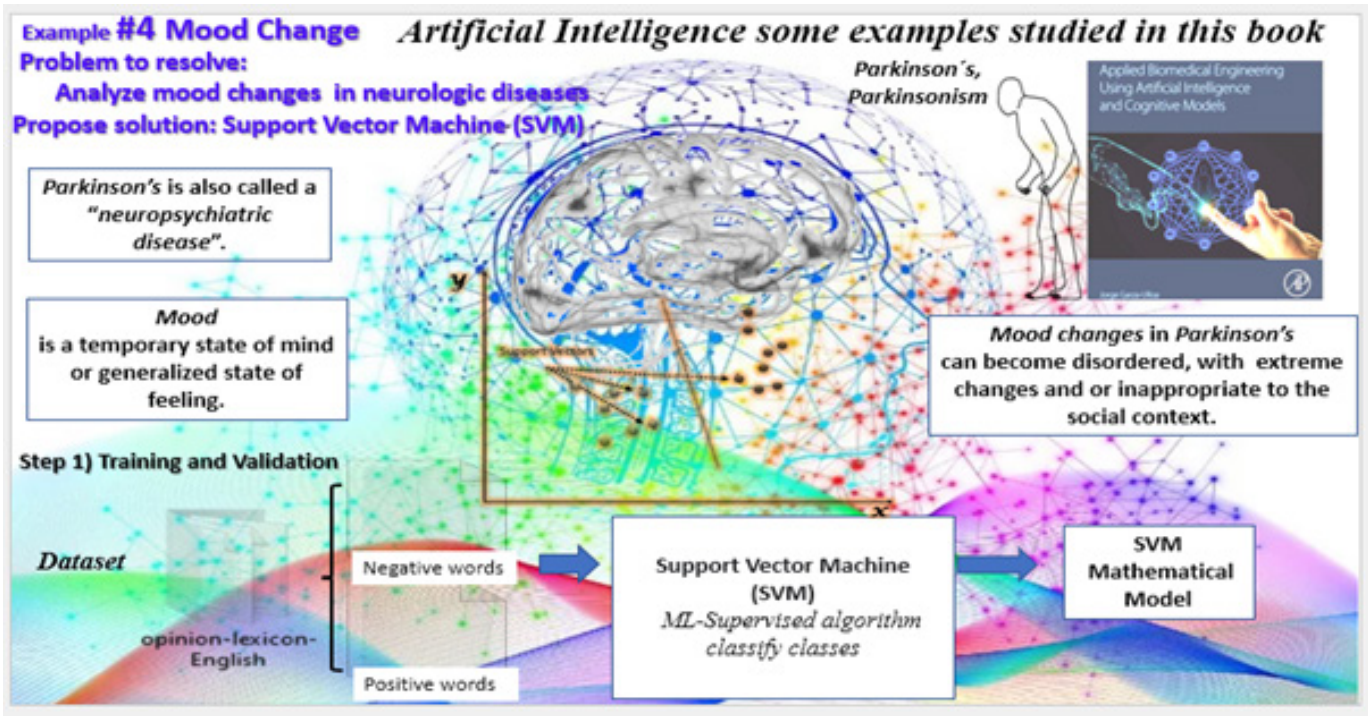

Figure 13: AI Flashcard problem to resolve: Analyze mood changes in neurologic diseases as Parkinson's also known as "neuropsychiatric disease". Where Mood is a temporary state of mind or generalized state of feeling. Propose solution: "Support Vector Machine (SVM)". The step 1) consist of a training and validation of 2 text files: negative words and positive words to a Support Vector Machine (SVM) algorithm to obtain an SVM Mathematical Models".

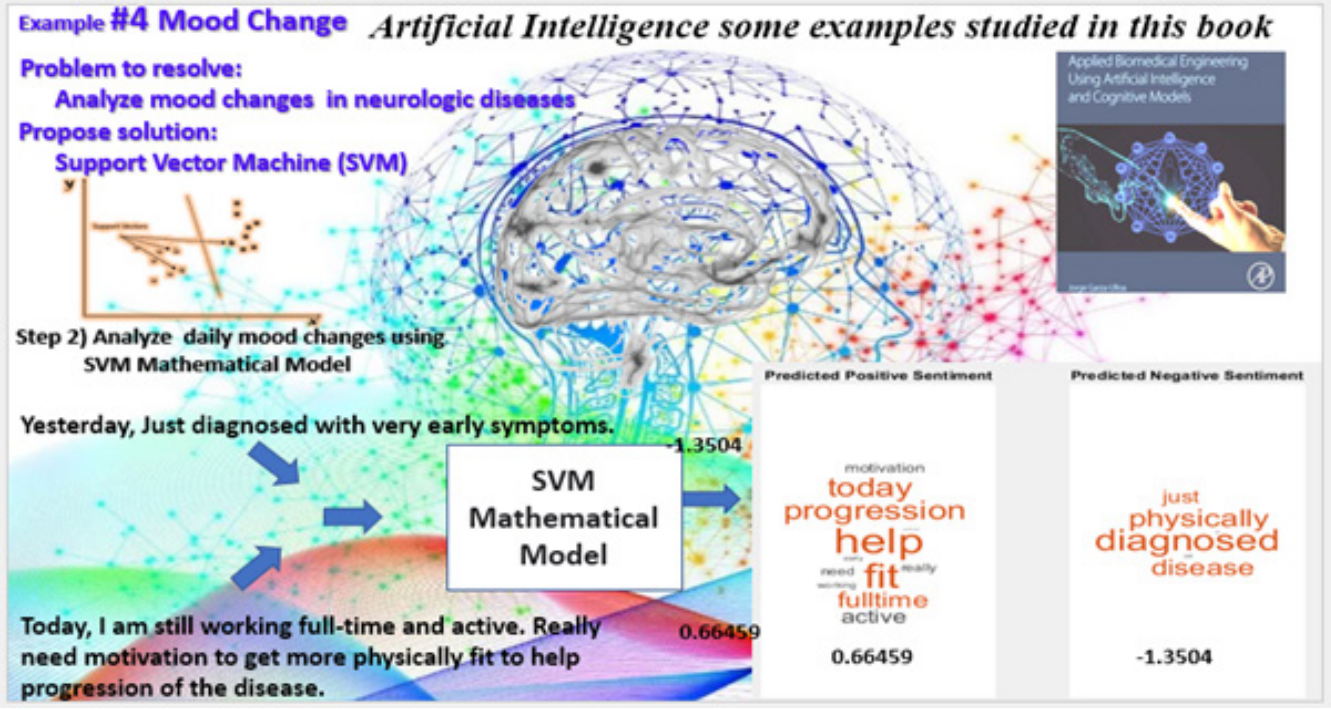

Figure 14: AI Flashcard Shown the 2nd step to analyze mood changes in neurologic diseases applying a SVM Mode. The input is feed with an expressive expression of how he was feeling yesterday and a today expressive expression, then the "SVM Mathematical Model" analyze them as an negative sentiment for yesterday vs a positive sentiment for today.

Free Download BOOK Companion with Exercises and Researches

Applied Biomedical Engineering Using Artificial Intelligence and Cognitive Models provides readers with the study of injuries, illness, and neurological diseases of the human body through Artificial Intelligence using Machine Learning (ML), Deep Learning (DL) and Cognitive Learning (CL) known also Cognitive Computing (CC) models based on algorithms developed with MATLAB® and IBM Watson® that you can download by free at:.

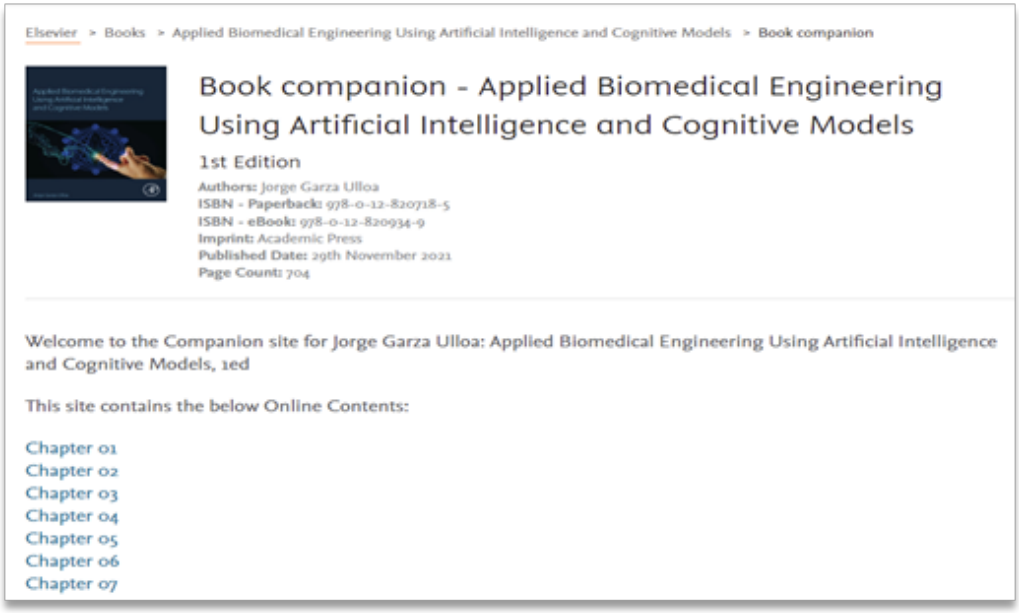

Figure 15: with MATLAB® and IBM Watson® free download at *https://www.elsevier.com/books-and-journals/book-companion/9780128207185*.

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Figure 16: Free read first 2 chapters at *Applied Biomedical Engineering Using Artificial Intelligence and Cognitive ... - Google Books.* https://www.google.com/books/edition/Applied_Biomedical_Engineering_Using_Art/NiMZEAAAQBAJ?hl=en&gbpv=1&printsec=frontcover.

Book Reviews and comments

a. Ubaldo Inclán (Univergi International) Congratulations, Dr. Jorge Garza, I began to read your book, very interesting and on the most transformative topic perhaps in the history of humanity. Artificial Intelligence is the first revolution that will take us from the human to something non-human or hybrid. Essential reading. A big hug.

b. Jorge Young (President of Cluster Metropolitano de Energía. México City) A book by a great specialist in Artificial Intelligence and corresponding subjects, Dr Garza Ulloa-Ulloa takes us to the present and the future in a transcendental and futuristic theme. It is a great pleasure that Dr Garza-Ulloa has made that great creative effort to write a book that will surely become a classic in that matter.

c. Dr Carlos Yates (president of the Energy Cluster of Chihuahua) Dear Dr. Jorge Garza Ulloa. Congratulations on your transcendental book of Artificial Intelligence and Bioengineering focused on the search for solutions that benefit humanity. Thanks a lot.

d. Marcos Barraza (Artificial Intelligence expert former Tesla employee) Dr Jorge Garza Ulloa is a pride for humanity; a great brain wrapped in a simple and kind man who generously imparts his knowledge to his students and the public. A strong hug Jorge and a great luck to be your friend.

Acknowledgment

None.

Conflict of Interest

None.