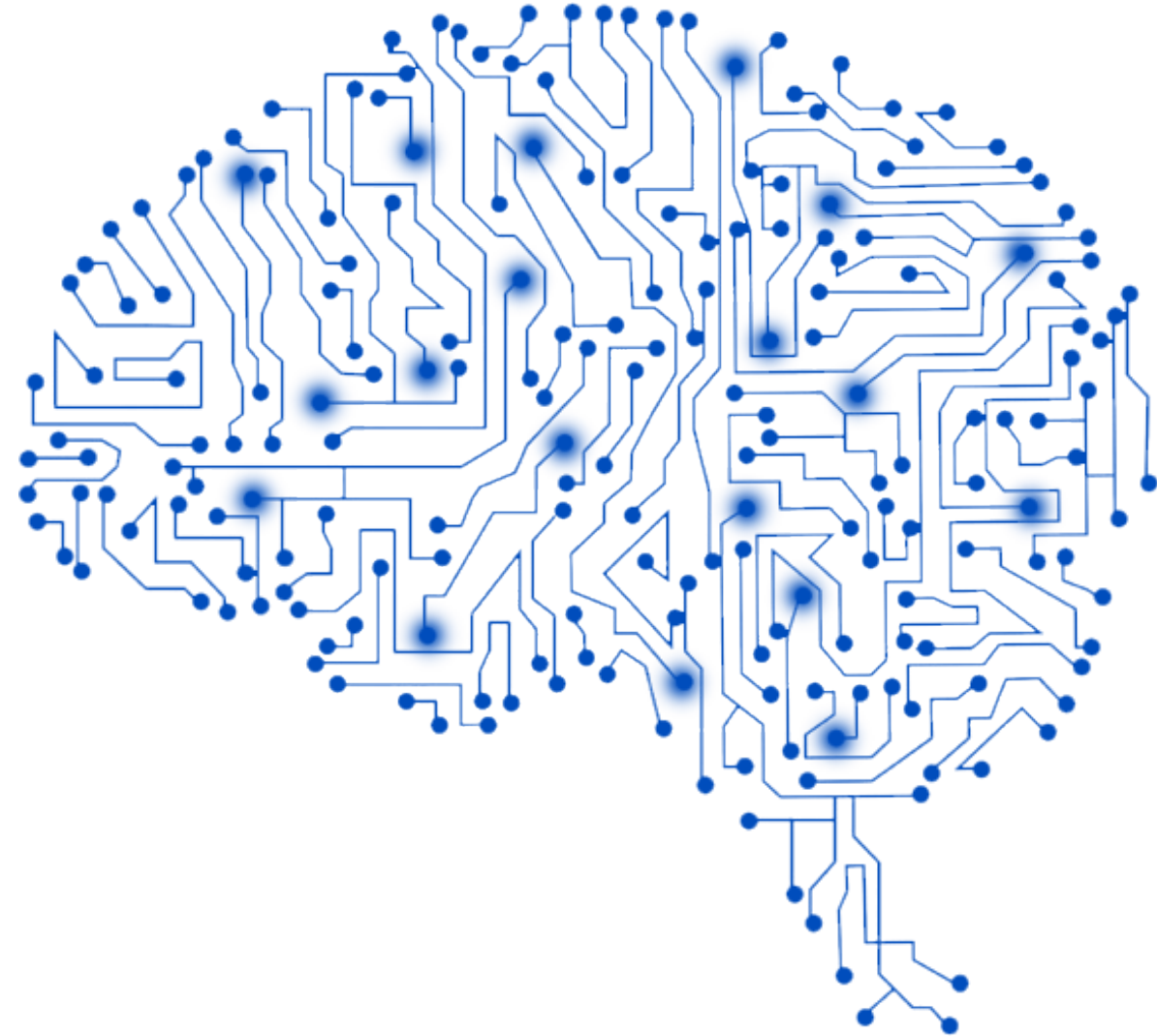


# Exploiting Recent Advances in Deep Learning

Ahmed Elnaggar, 21.09.2017, SEBIS Workshop

Chair of Software Engineering for Business Information Systems (sebis)  
Faculty of Informatics  
Technische Universität München  
[www.matthes.in.tum.de](http://www.matthes.in.tum.de)

1. **Biography**
2. **Latest Research - Hand Therapy:**
  - Background
  - Gesture Recognition
  - Pain Recognition
3. **Evolution of Deep Learning Models**
  - Single Task : Single Modality (images, speech, text))
  - Single Task: Multi Modality
  - Multi Task: Single Modality
  - Multi Task: Multi Modality
4. **Outlook**



## 1. Biography

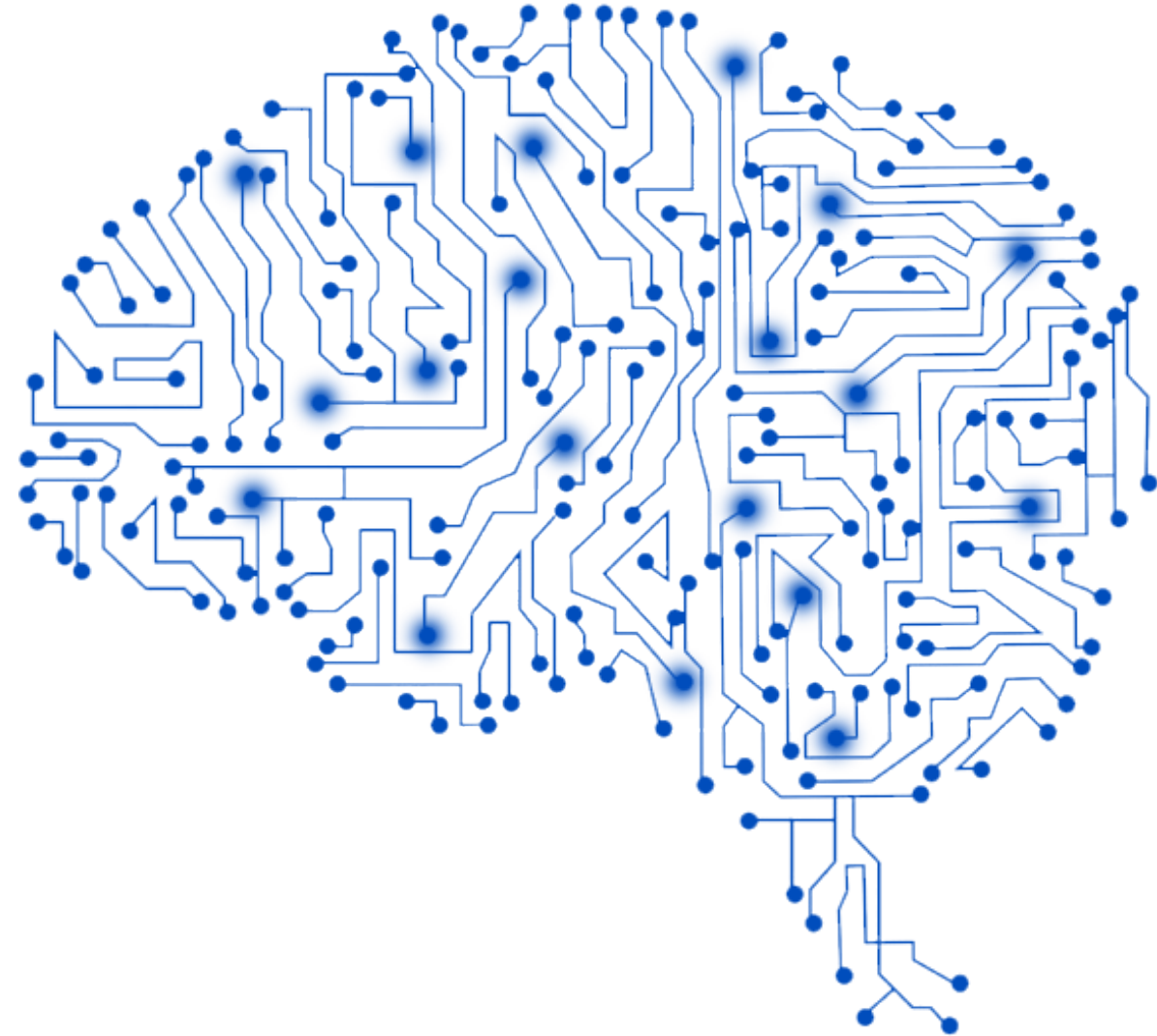
## 2. Latest Research - Hand Therapy:

- Background
- Gesture Recognition
- Pain Recognition

## 3. Evolution of Deep Learning Models

- Single Task : Single Modality (images, speech, text))
- Single Task: Multi Modality
- Multi Task: Single Modality
- Multi Task: Multi Modality

## 4. Outlook

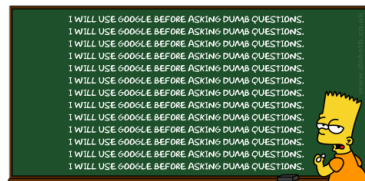




- Deep Learning, Machine Learning, Artificial Intelligence
- Computer Vision, Natural Language Processing, Robotics



- 2009 BSc CS- University of District of Columbia (USA)
- 2014 MSc CS - Arab Academy for Science and Technology (Egypt)
- 2015 German University in Cairo
- 2017 DHBW Stuttgart
- Currently PhD Cs - Technical University of Munich (Germany)



- Robotica - Cambridge University Press
- Google – Google Developer Groups “Google I/O Extended”



## 1. Biography

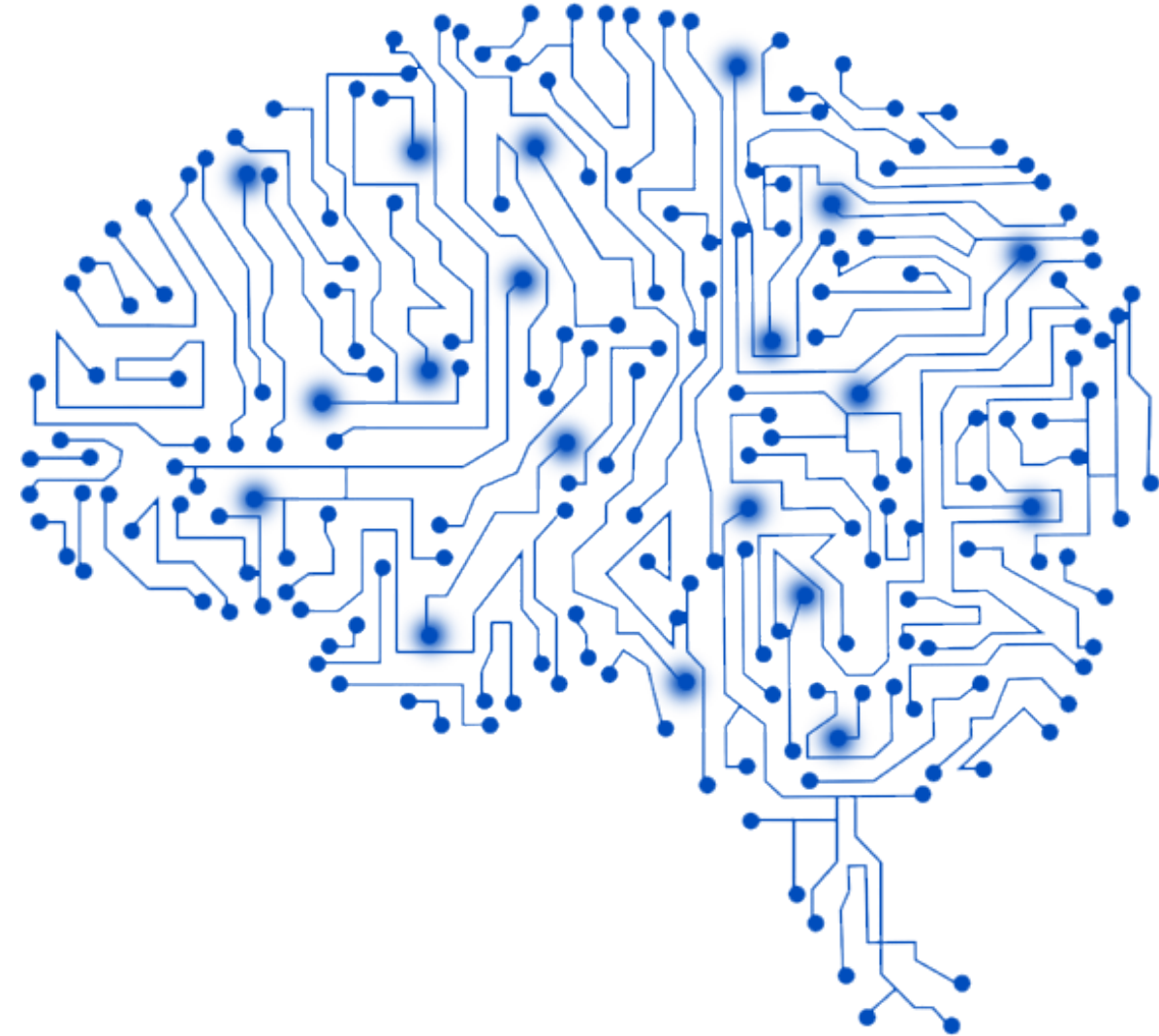
## 2. Latest Research - Hand Therapy:

- Background
- Web Based System Solution
- Gesture Recognition
- Pain Recognition

## 3. Evolution of Deep Learning Models

- Single Task : Single Modality (images, speech, text))
- Single Task: Multi Modality
- Multi Task: Single Modality
- Multi Task: Multi Modality

## 4. Conclusion





## Intro

- Injuries to the hand are more common than those of any other body region
- Repetitive Stress Injuries, lacerations and crushing are just a few common injuries to hand.
- Such injuries are treated through hand rehabilitation



## Problems

- **Government:**
  - Expensive:
    - US => 16 billion euro
    - DE => 2 billion euro
- **Patient:**
  - Expensive
  - Boring
  - Time Consuming
  - Portability
- **Researcher:**
  - Data
  - Accuracy
  - Cost
  - Medical Information



# Hand Therapy - Web-Based System Solution

Hand Therapy Analysis

Joint Angles

Step 1: MCP Angles

Pinky Finger MCP: 74°

Ring Finger MCP: 77°

Middle Finger MCP: 64°

Index Finger MCP: 64°

Put your hand in any position that does not cover your MCP joint (Pure MCP) to record the pinky, ring, middle and index fingers MCP joint angles.

Click the "Start Recording #1" button and keep the same hand position for three seconds, then move your hand away of the device.

Click the "Start Recording #2" button and keep the same hand position for three seconds, then move your hand away of the device.

Click the "Next Step" button.

You can track your hand movement from the above hand simulator.

Now move your fingers outwards while keeping them straight

Score: 1

Timer: 00:40

Hand Therapy Analysis

Joint Angles

Report:

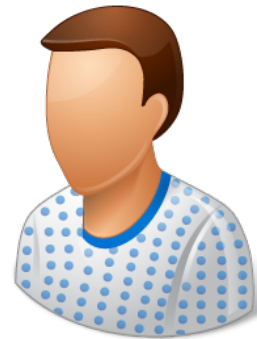
Finger Name	MCP Angle	PIP Angle	DIP Angle	Length	Width
Pinky	83.92	87.75	80.41	6.91	1.54
Ring	84.00	88.23	80.73	8.72	1.73
Middle	84.00	88.15	83.12	9.13	1.82
Index	84.40	87.84	82.99	8.06	1.85
Thumb	0.00	40.12	76.06	5.50	1.94

Cumulative Score: 30

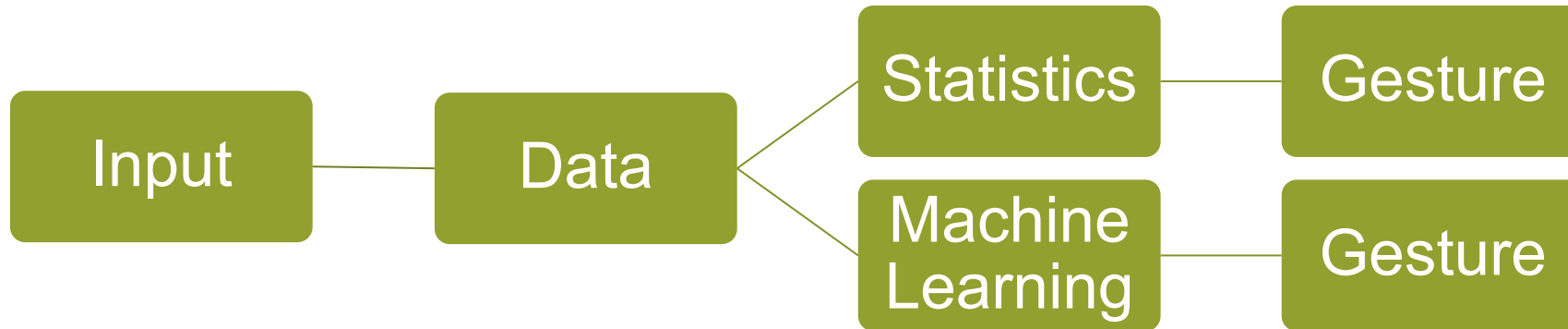
Score: 20

'Q' to Quit Game!

96%

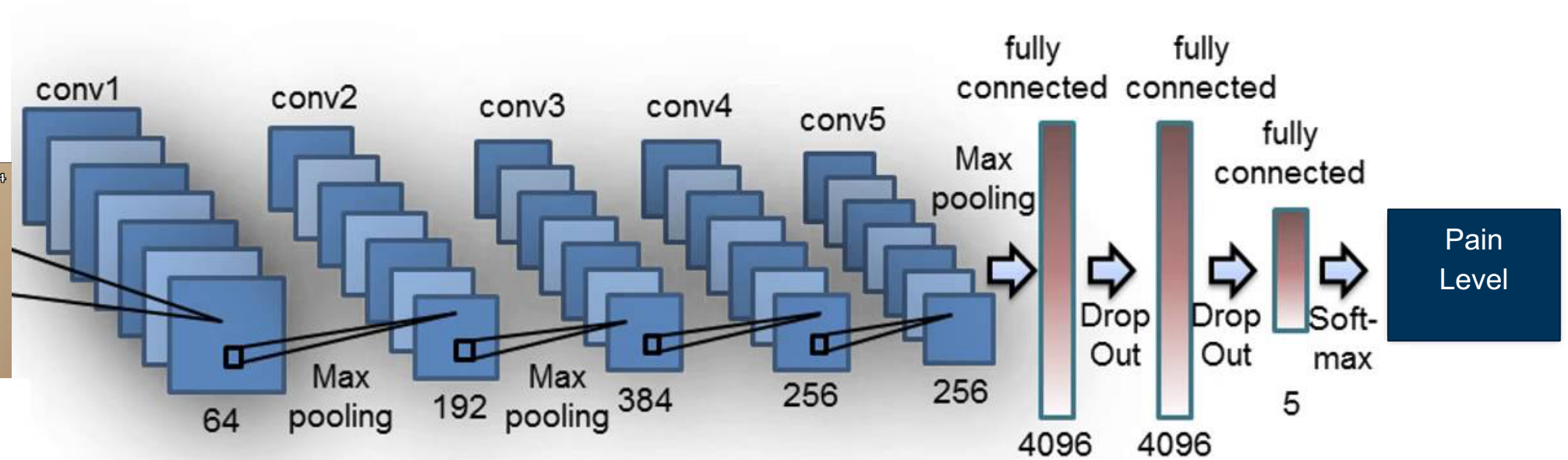


# Hand Therapy - Gesture Recognition

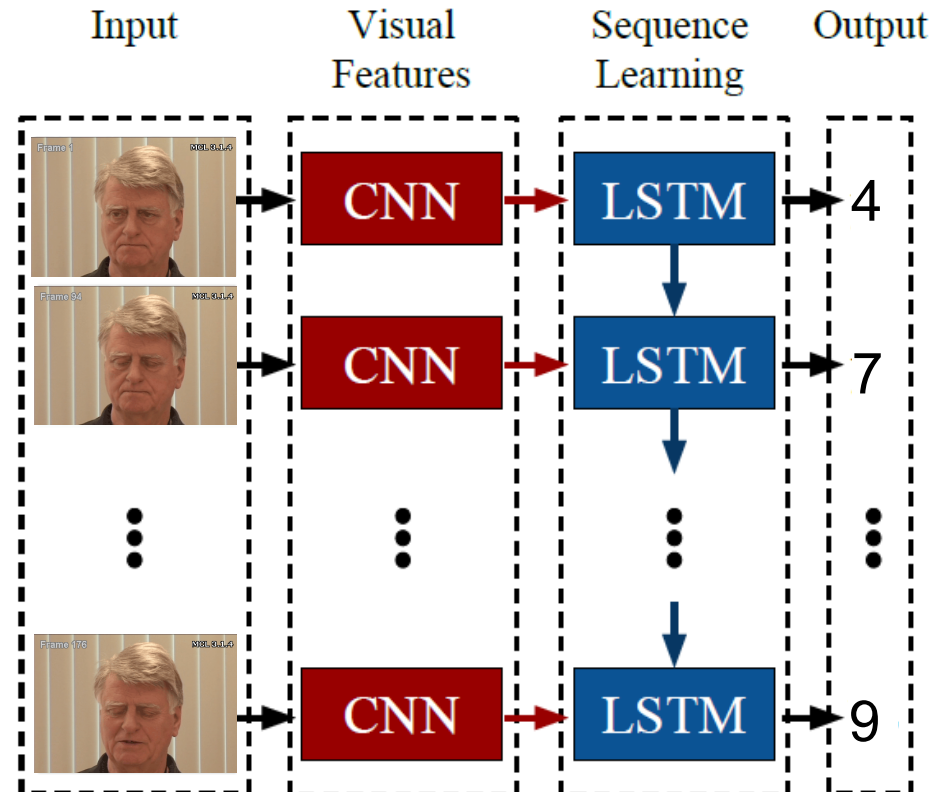




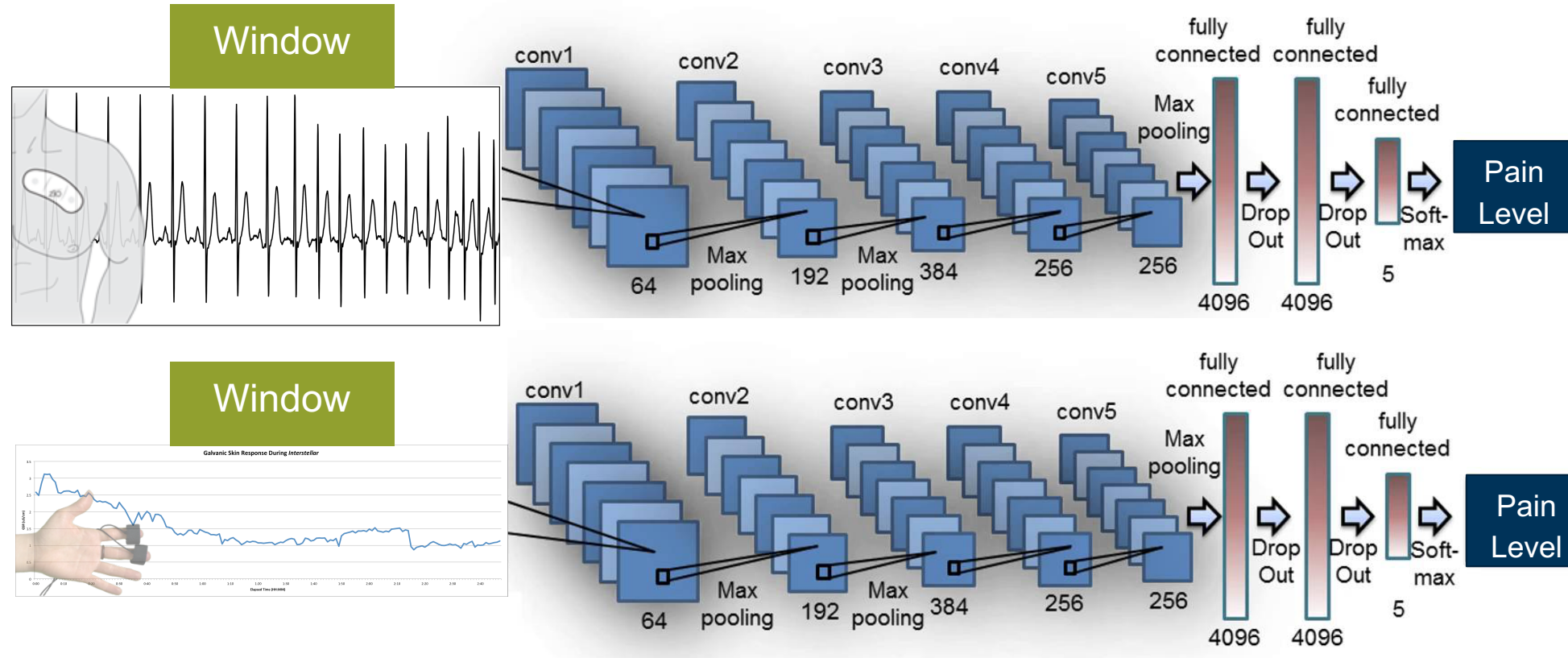
## Convolutional Neural Network (CNN)



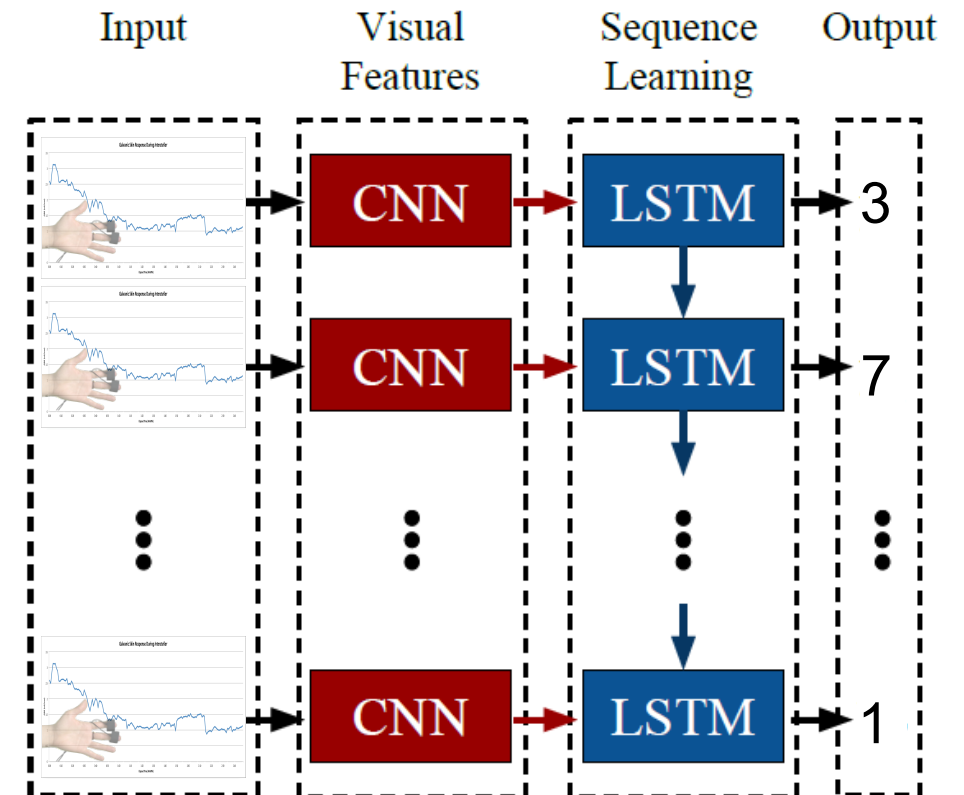
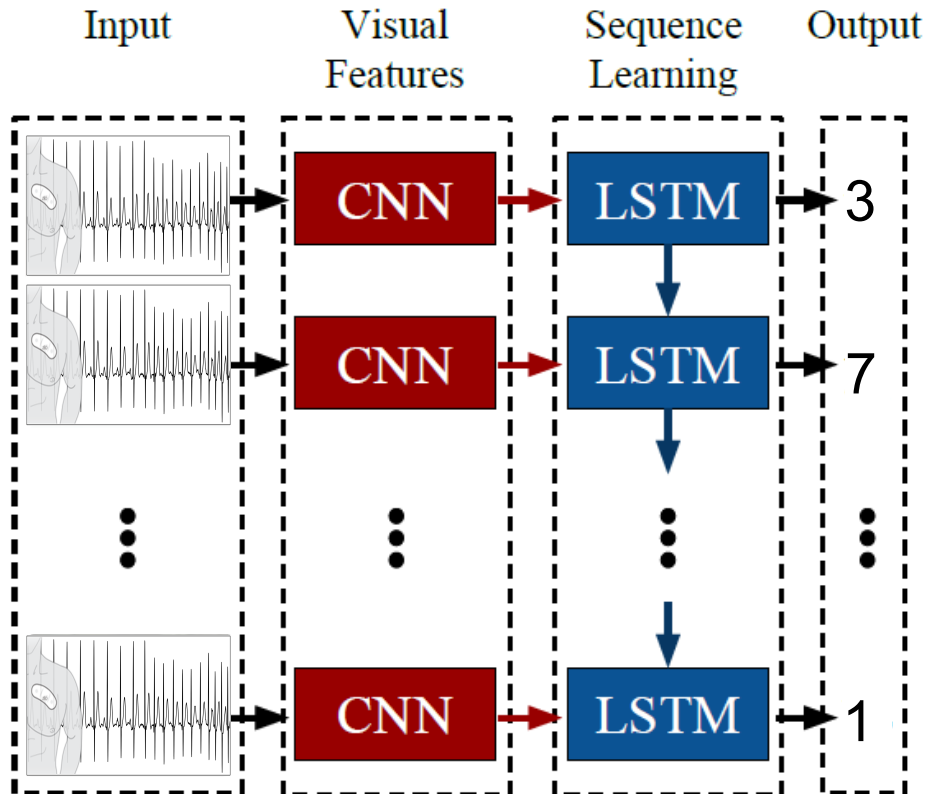
## CNN & Long Short Term Memory Network (LSTM)



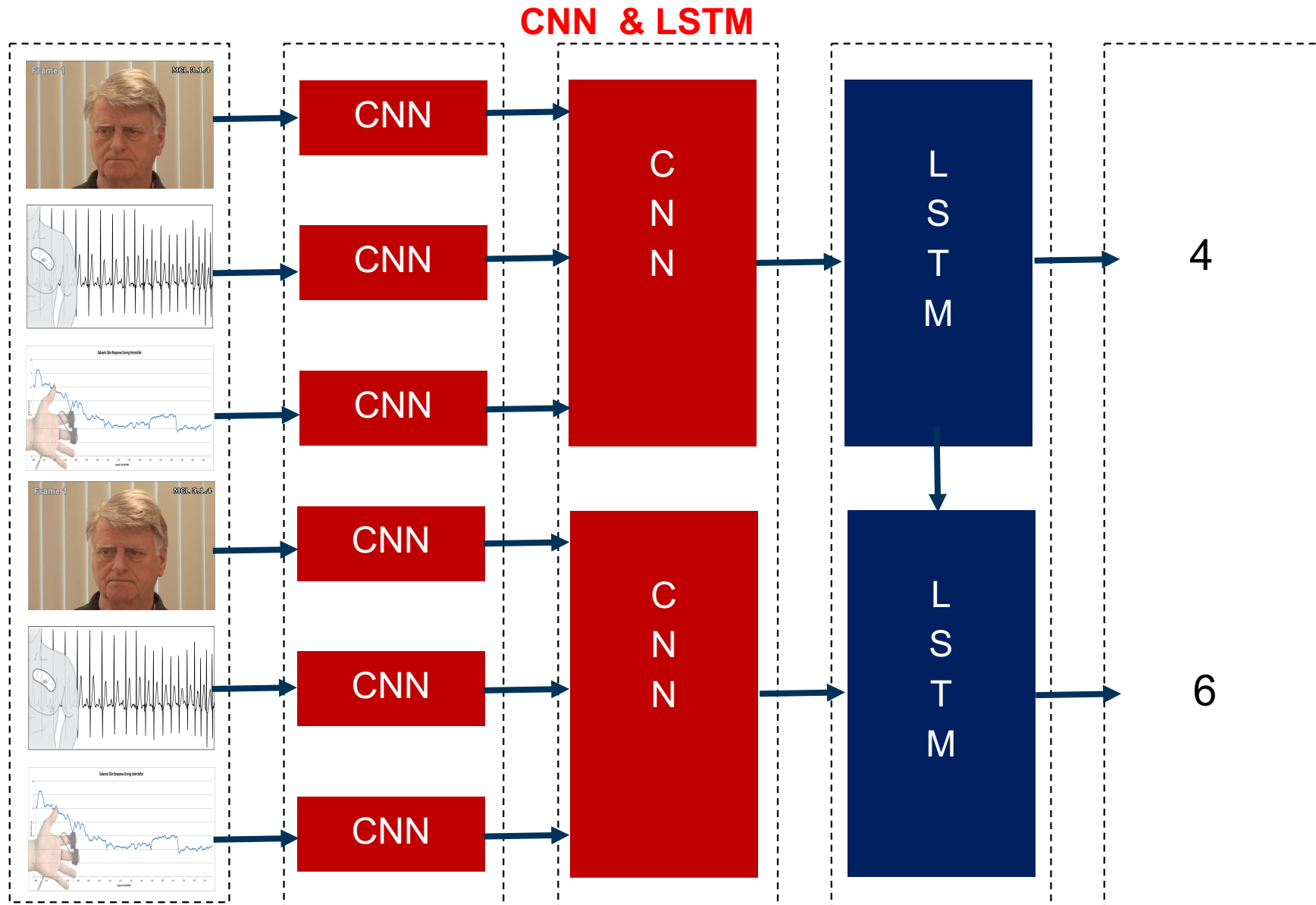
## CNN



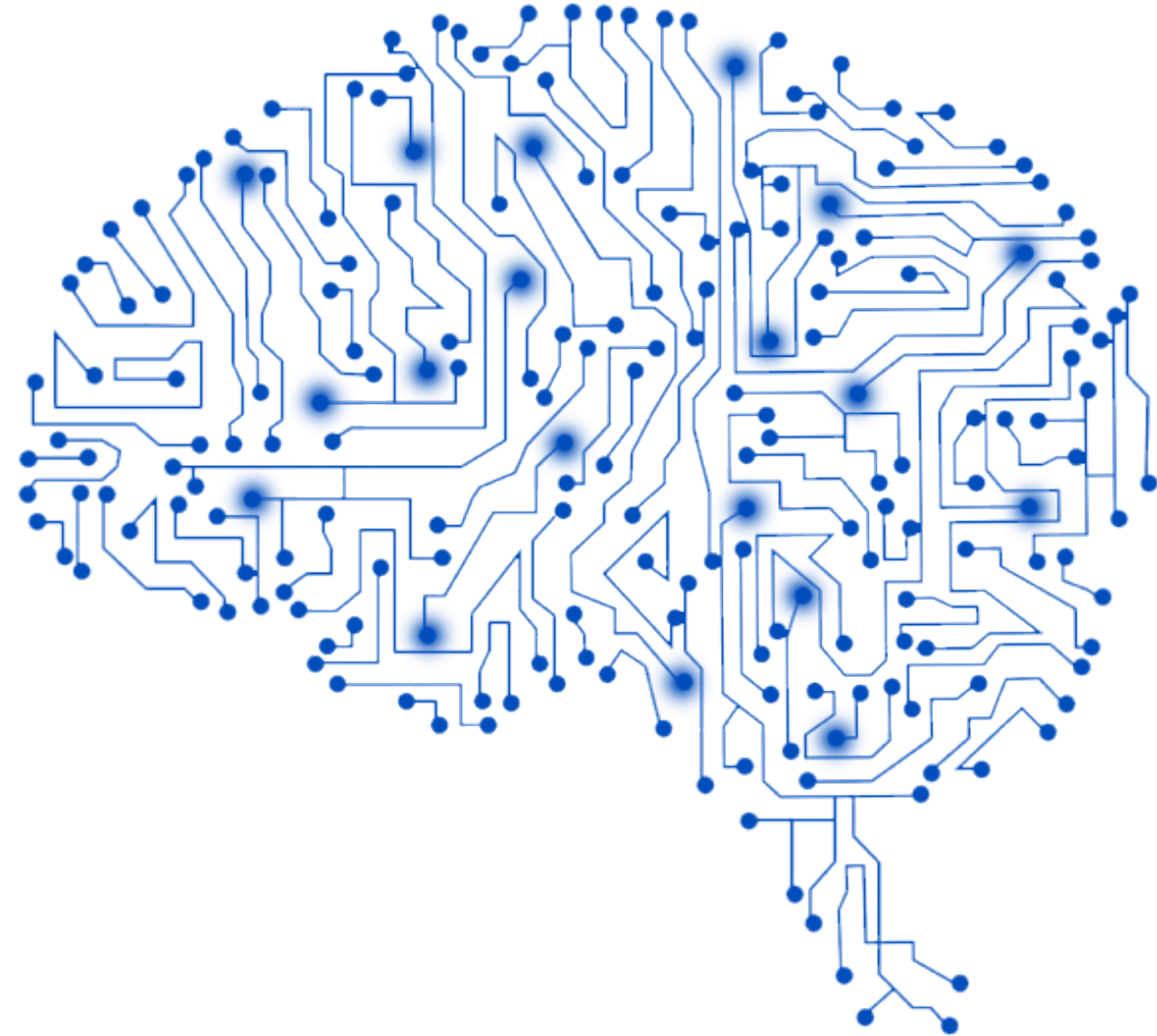
## CNN & LSTM



# Hand Therapy – Pain Recognition : Multi Sensor



1. **Biography**
2. **Latest Research - Hand Therapy:**
  - Background
  - Gesture Recognition
  - Pain Recognition
3. **Evolution of Deep Learning Models**
  - Single Task : Single Modality (images, speech, text))
  - Single Task: Multi Modality
  - Multi Task: Single Modality
  - Multi Task: Multi Modality
4. **Conclusion**





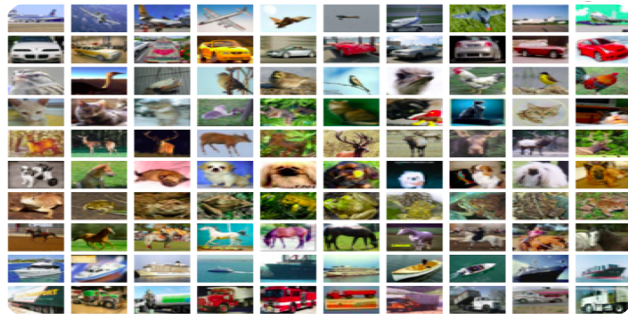
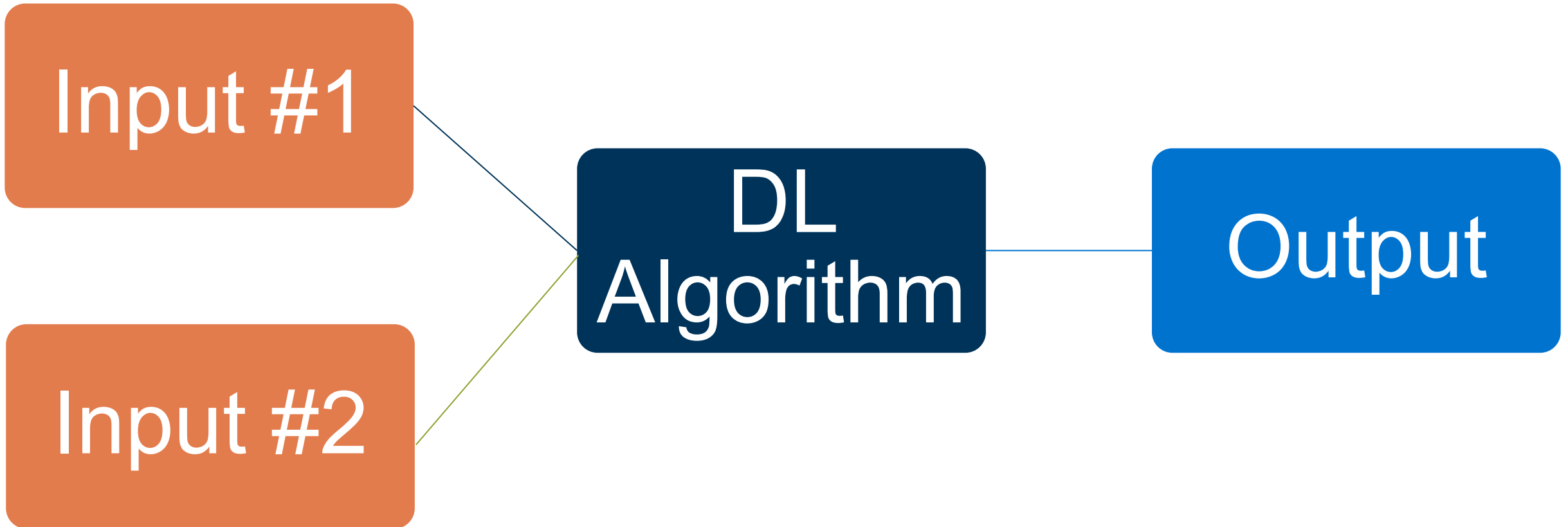


Image  
Classification  
Task

Image Class:  
Car







Tags:  
Sun  
Sky  
Sea

Image Classification Task

Image Class:  
Nature



Admission Form

NAME	DATE OF BIRTH	SEX	RELIGION	EDUCATION	PROFESSION
ADDRESS	CITY	STATE	COUNTRY	TELEPHONE	
DATE OF ADMISSION	ADMISSION FEE	ADMISSION STATUS	ADMISSION TYPE	ADMISSION DATE	ADMISSION TIME
ADMISSION OFFICE	ADMISSION OFFICER	ADMISSION OFFICER'S SIGNATURE	ADMISSION OFFICER'S TITLE	ADMISSION OFFICER'S ADDRESS	ADMISSION OFFICER'S PHONE

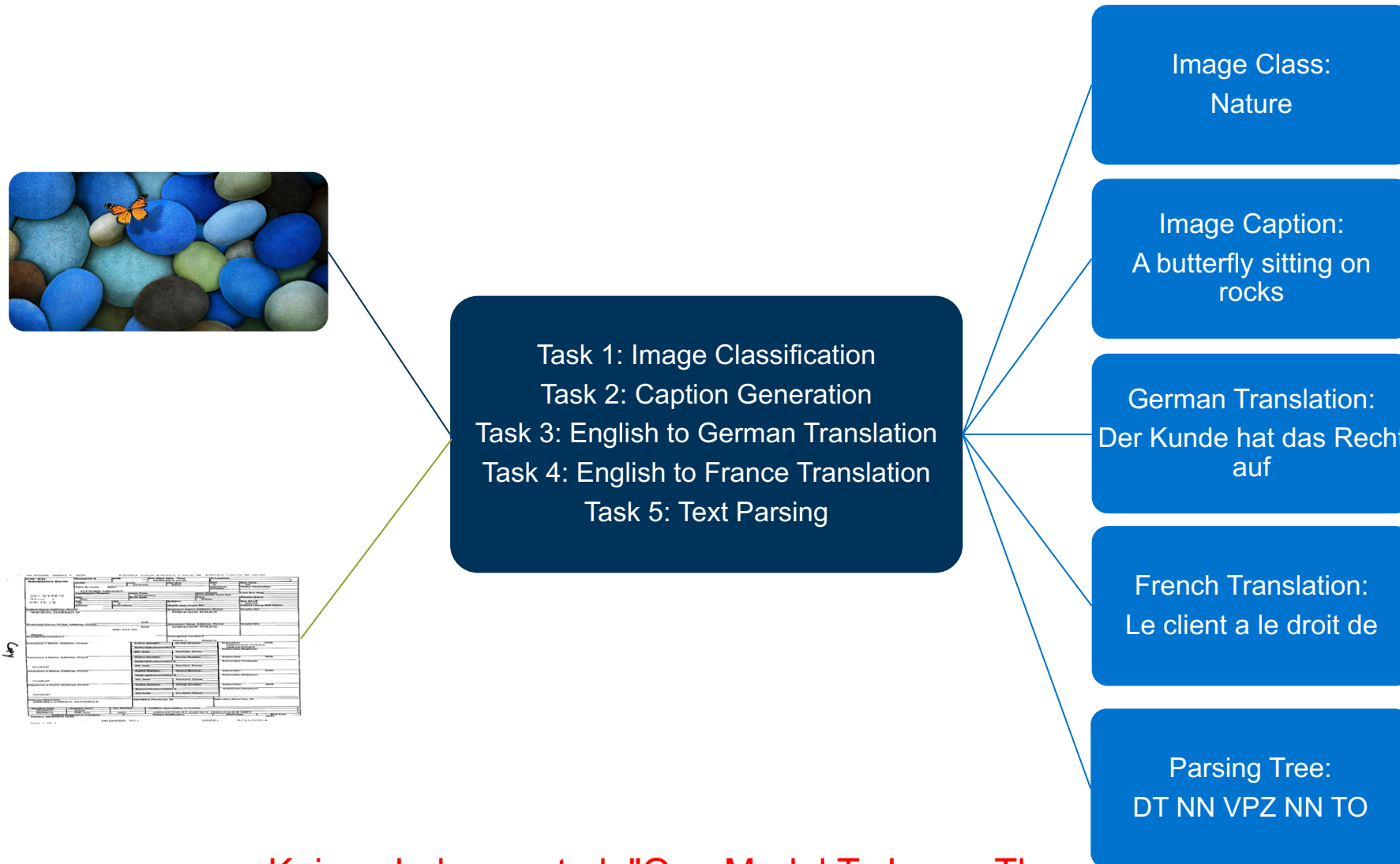
Task 1: Document Classification  
Task 2: Named Entity Recognition

Document Class:  
Rental Contract

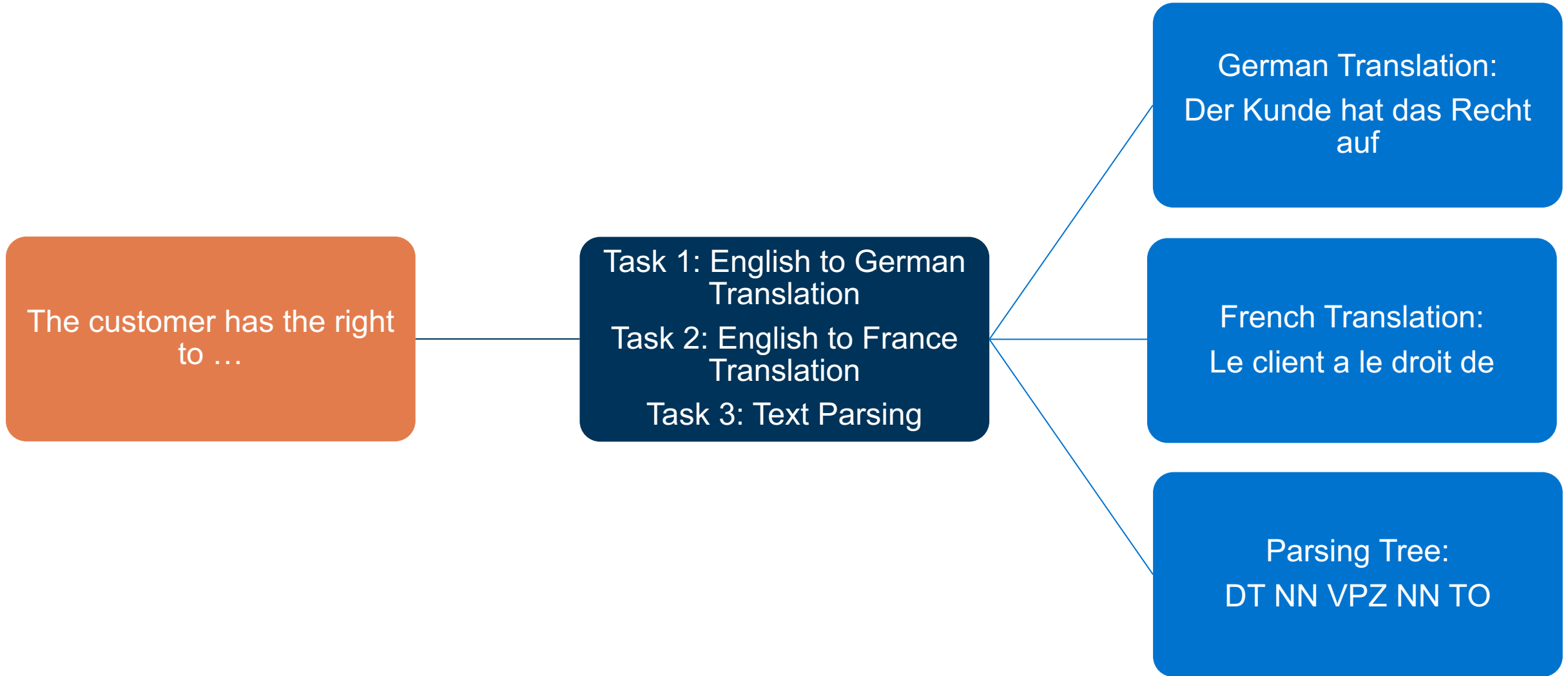
Name Entities:  
Google- organization  
Elon- person



# Deep Learning Models – Multi Task : Multi Modality



Kaiser, Lukasz, et al. "One Model To Learn Them All." *arXiv preprint arXiv:1706.05137* (2017).



**“Nvidia supported Us with 2 Powerful GPU cards”**

## Advantages:

1. Transfer of knowledge
2. Improve learning efficiency
3. Improve prediction accuracy
4. Save time/Money







MSc.

**Ahmed Elnaggar**

Technische Universität München  
Faculty of Informatics  
Chair of Software Engineering for Business  
Information Systems

Boltzmannstraße 3  
85748 Garching bei München

Tel +49.89.289.17126  
Fax +49.89.289.17136

ahmed.elnaggar@tum.de  
[www.matthes.in.tum.de](http://www.matthes.in.tum.de)

