

# Vision based obstacle avoidance using AI tools

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# Summary

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- Introduction
- Obstacle Detection in maritime robotics
- Introduction to YOLO for object detection

# Introduction

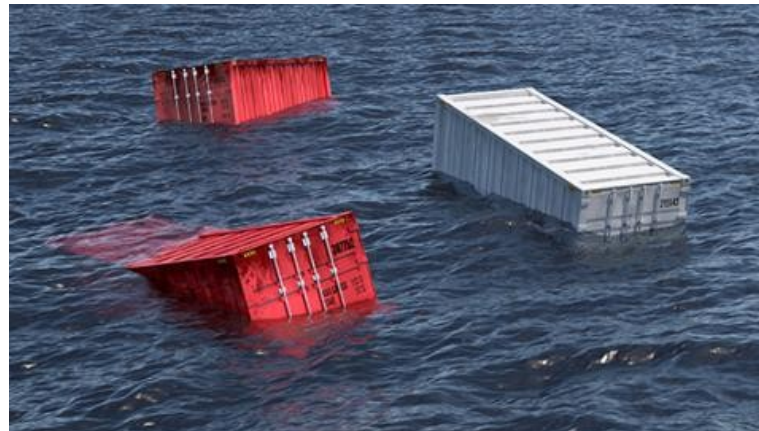
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# Obstacles in maritime robotics

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Boats

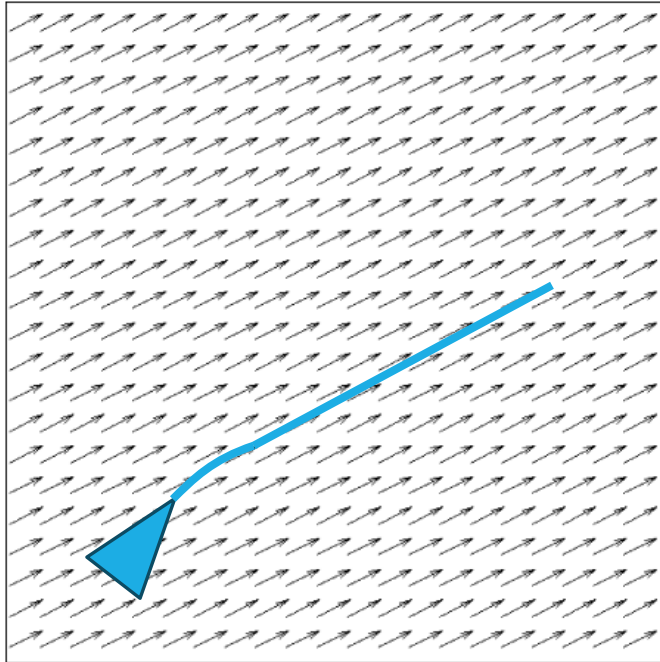


Unidentified floating  
object



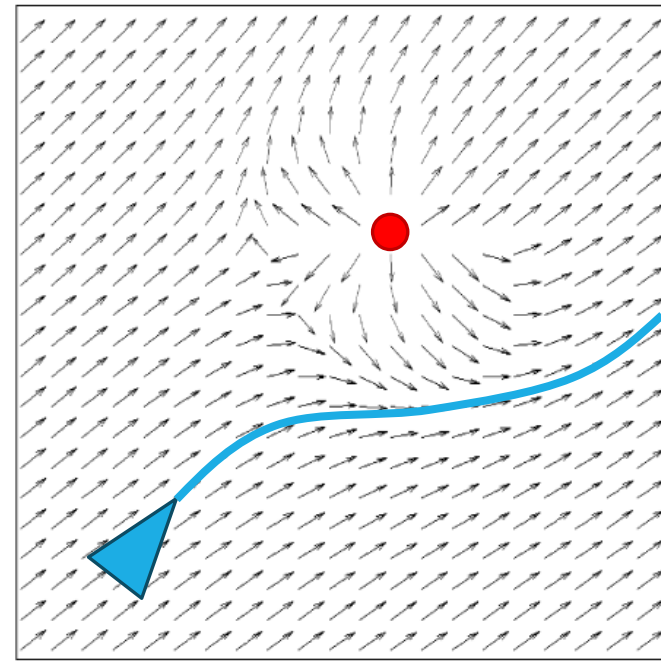
Animals

# Obstacle avoidance



From heading tracking

...



To obstacle avoidance

# Obstacle Detection in maritime robotics

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# What kind of sensors can we use ?

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- Vision

- RGB (Webcam)
  - Thermal camera

- LIDAR

- RADAR

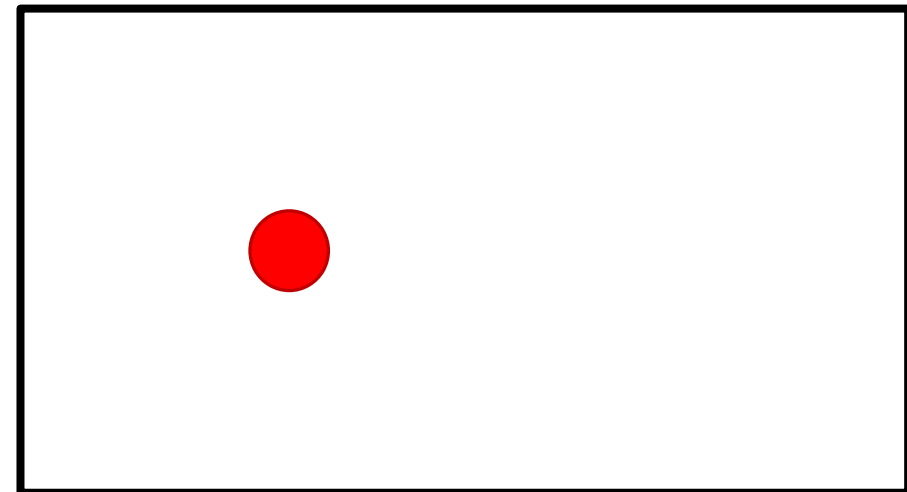
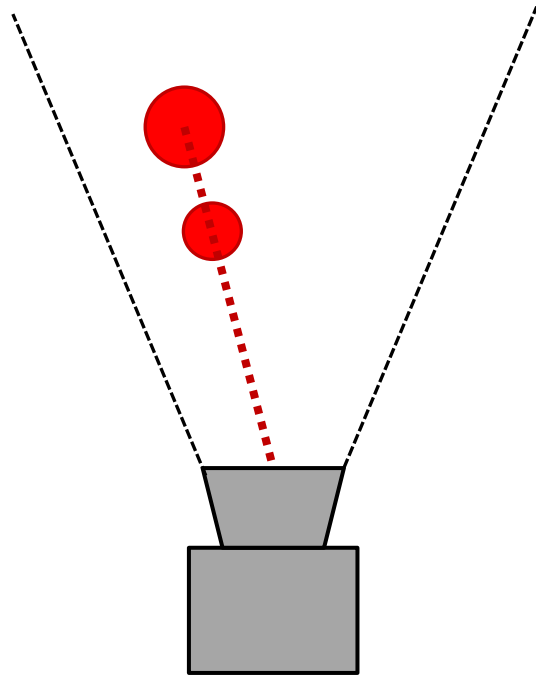
- Acoustics

Seeing an obstacle is good, locating it is better !

# Vision

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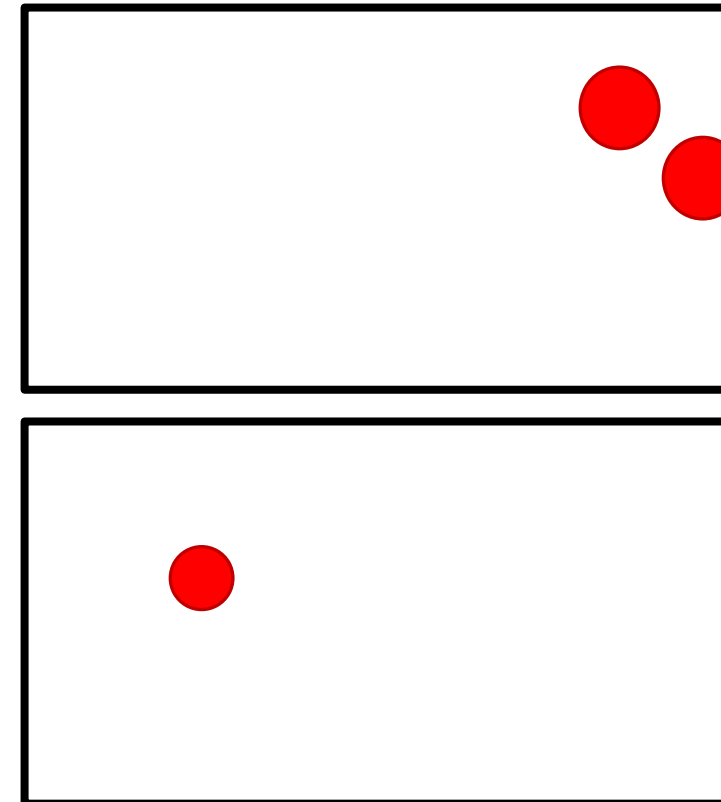
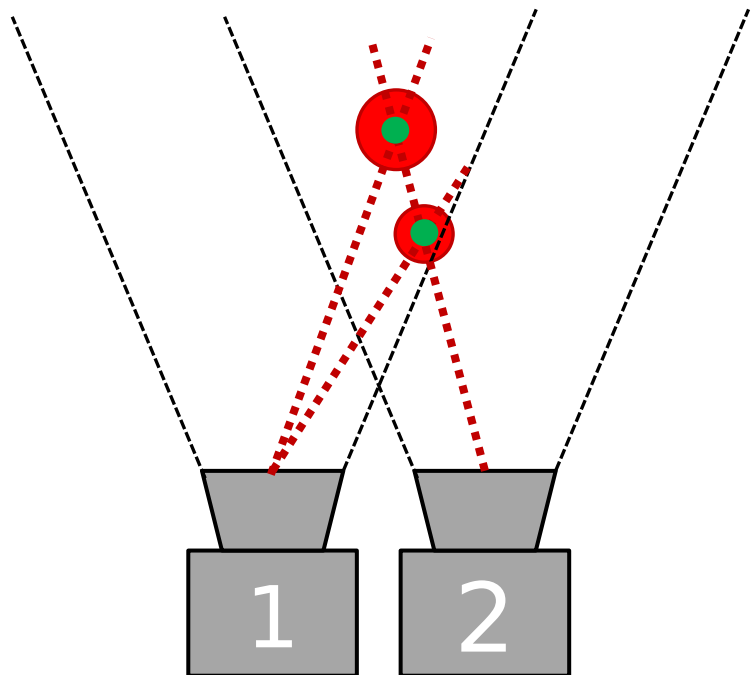
With a single camera





# Vision

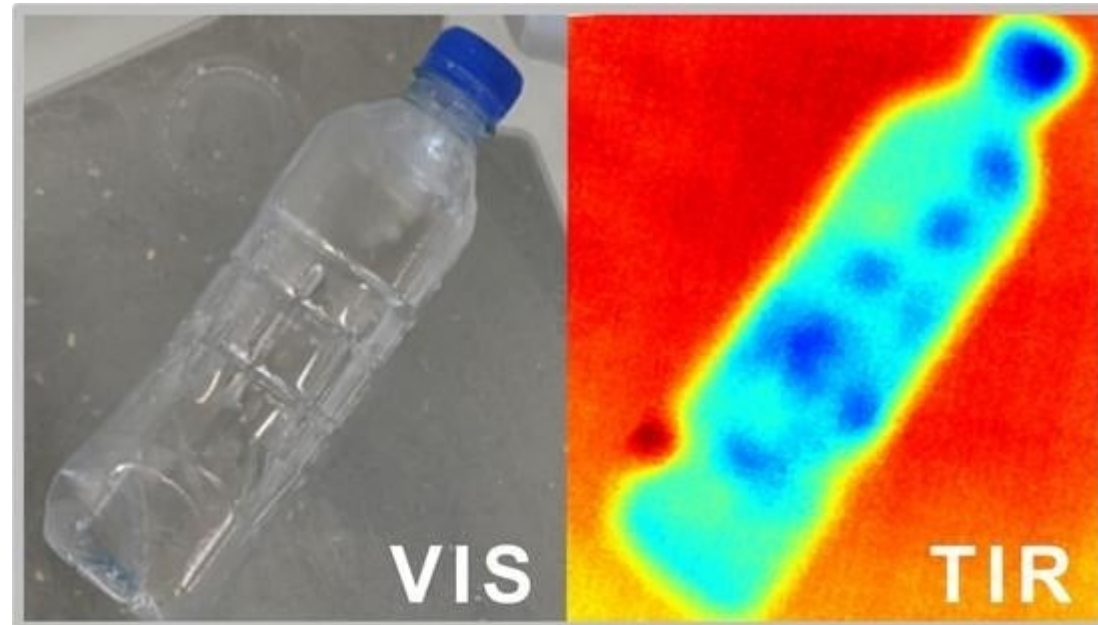
With two cameras : stereovision



# Vision

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With thermal camera



# Vision

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## Pros / Cons

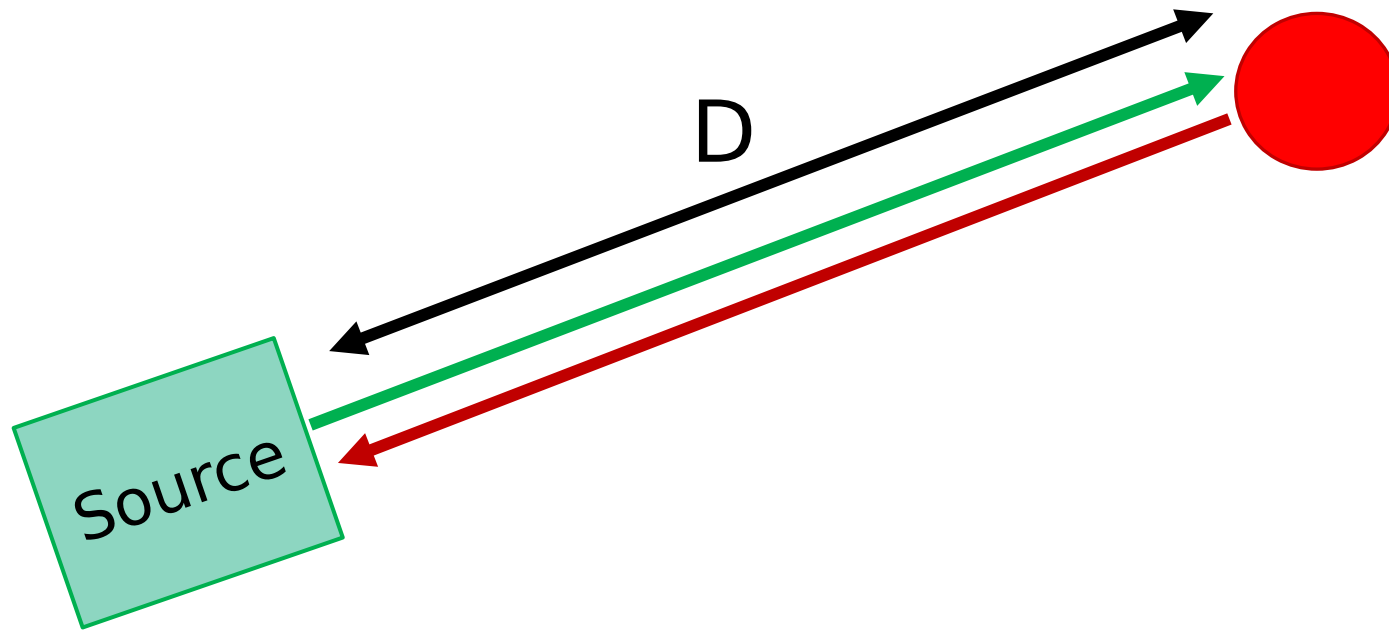
- + Works under water (short range)
- Obstacles hard to distinguish from the sea
- Waves



# LIDAR/RADAR

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Base principle

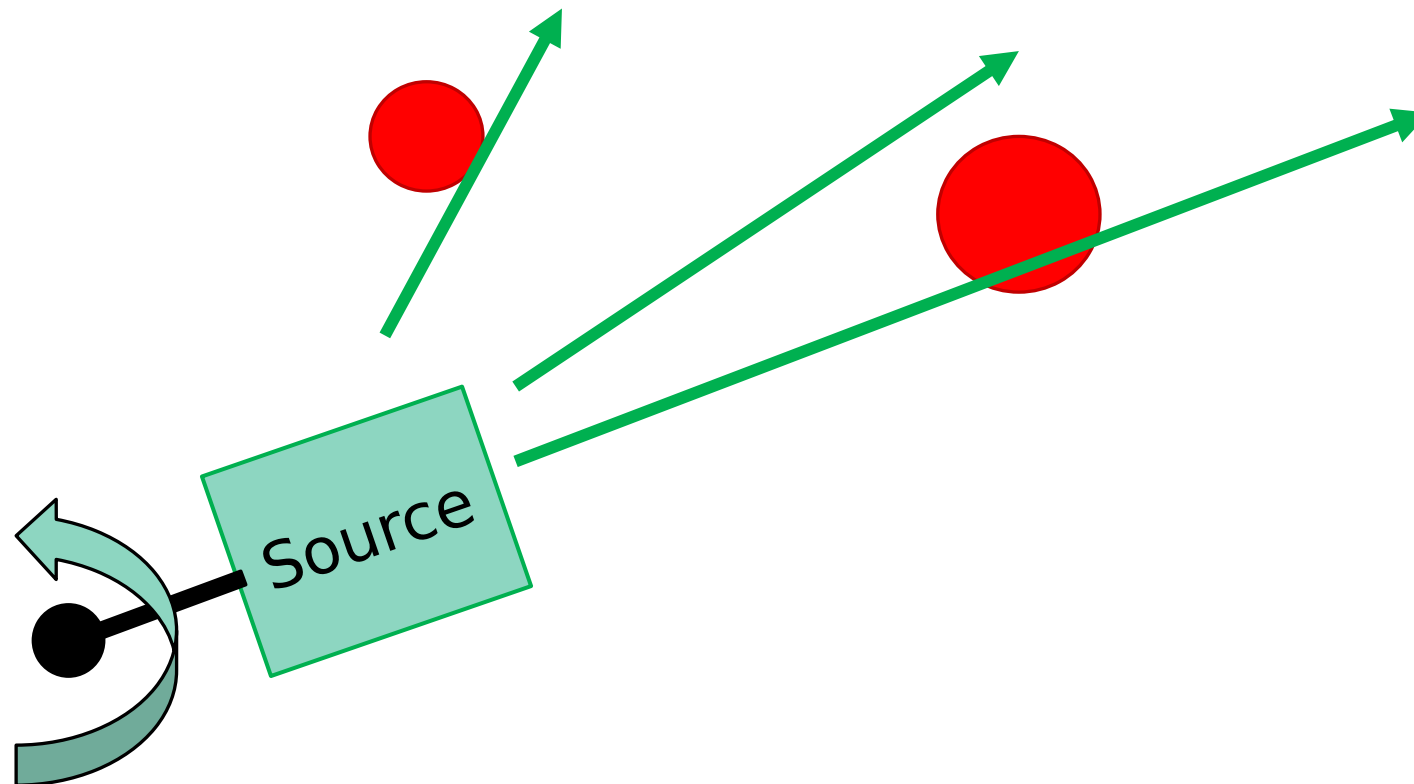


$$D = T * C / 2$$

# LIDAR/RADAR

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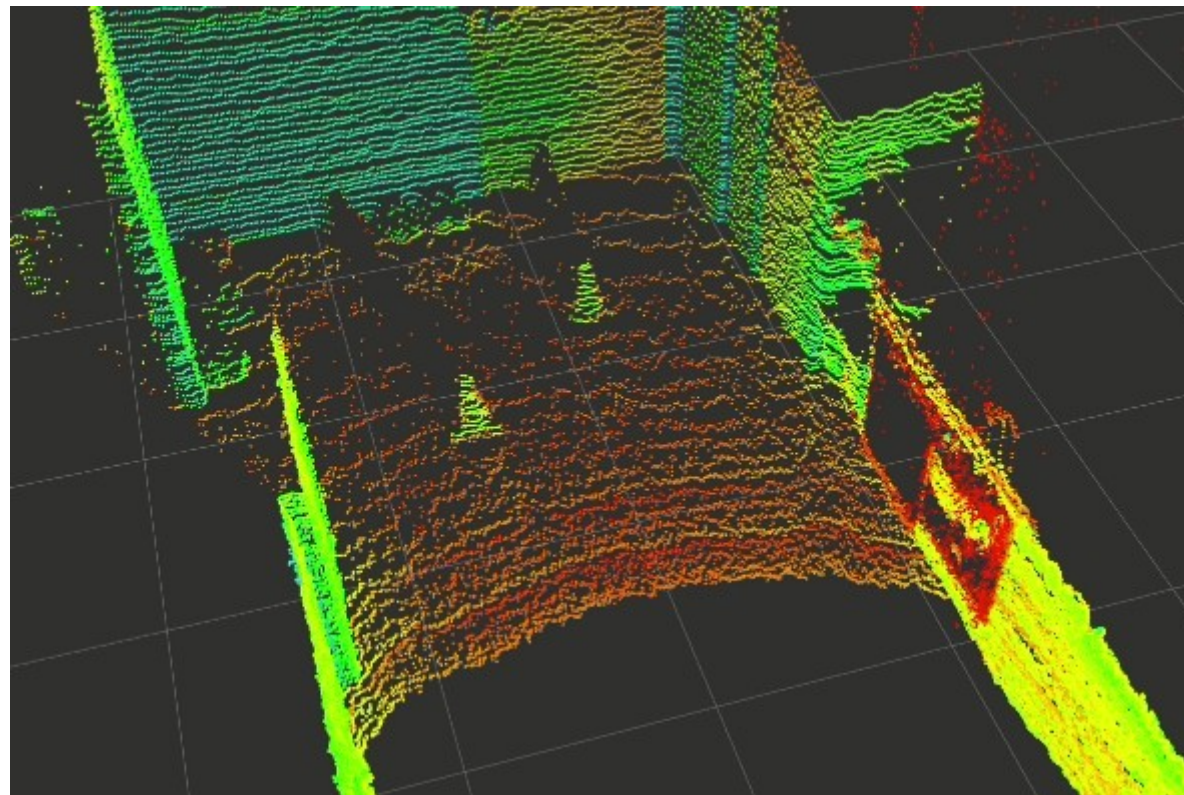
360°



# LIDAR/RADAR

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Result



# LIDAR/RADAR

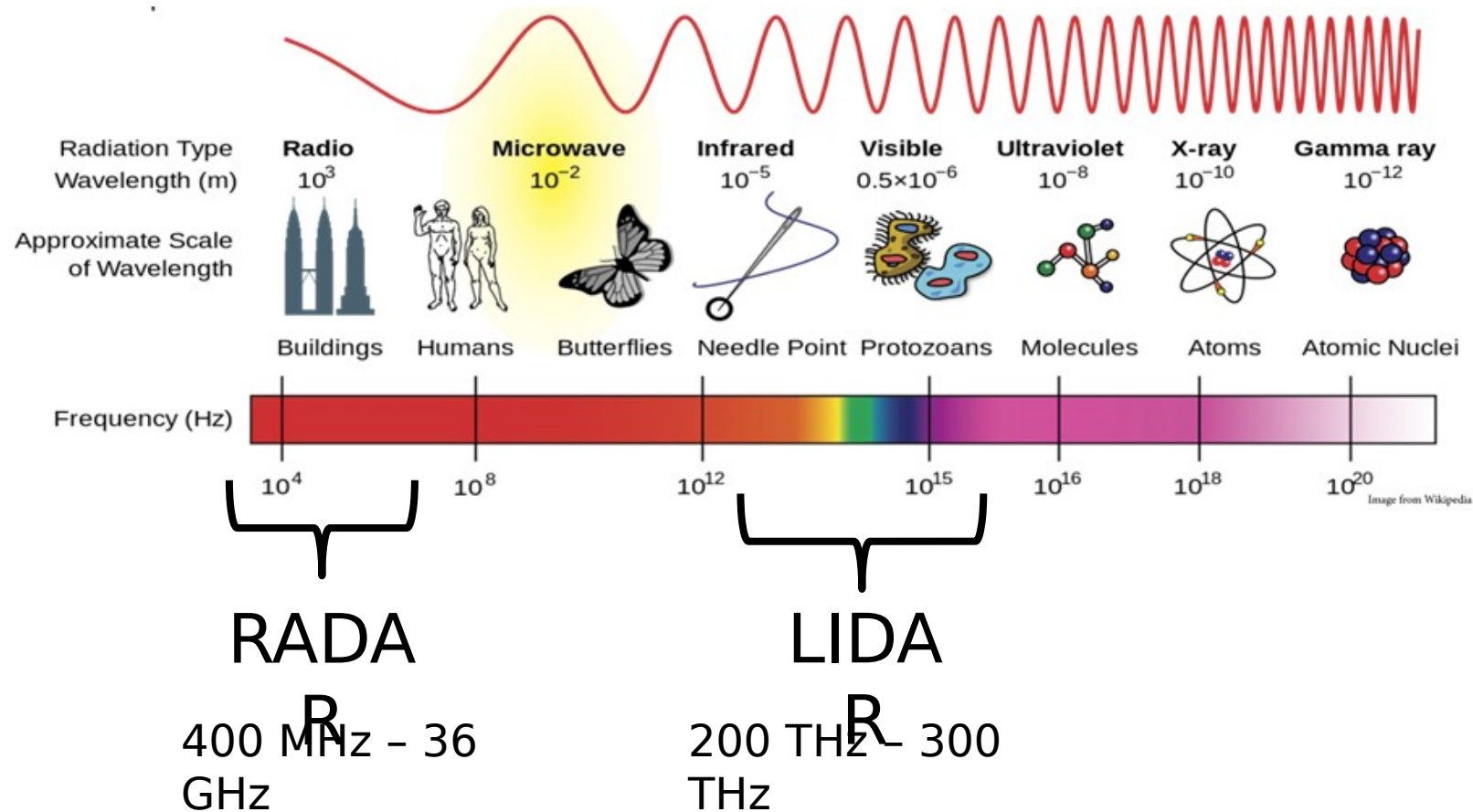
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Pros / Cons

- + Efficient for boat detections
- Cannot detect objects close to the water
- Active detection (pings)

What about under water ?

# LIDAR/RADAR

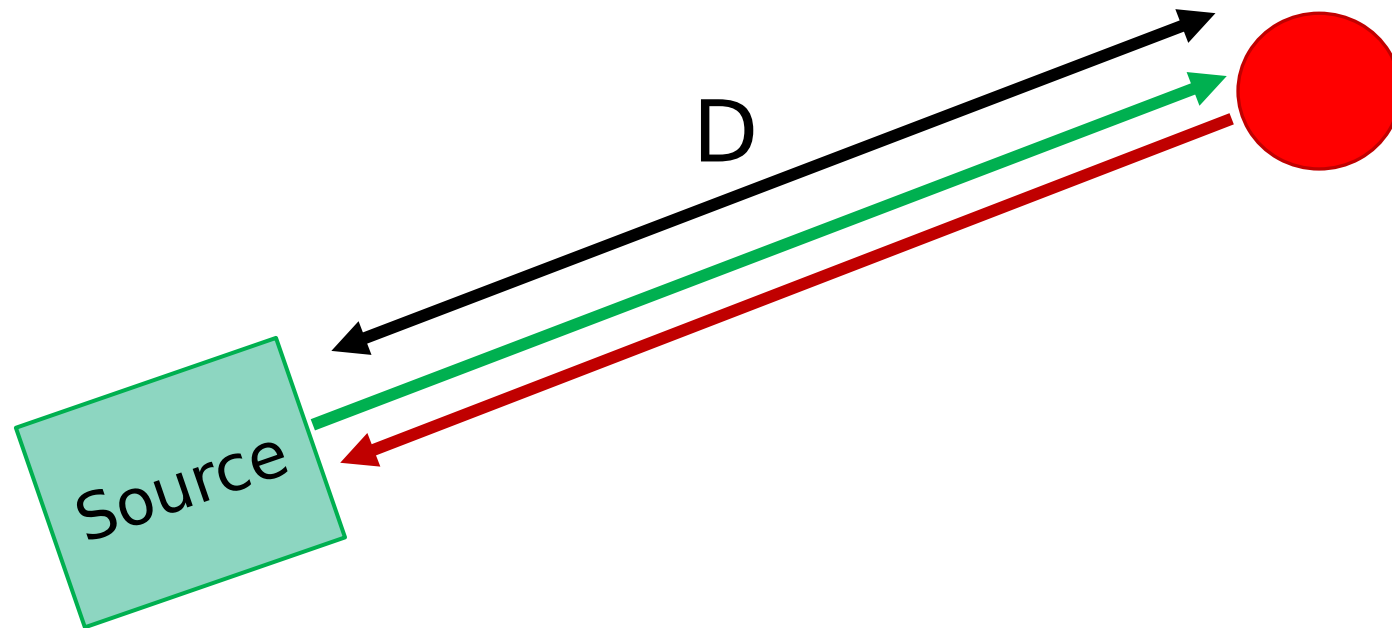




# Acoustics

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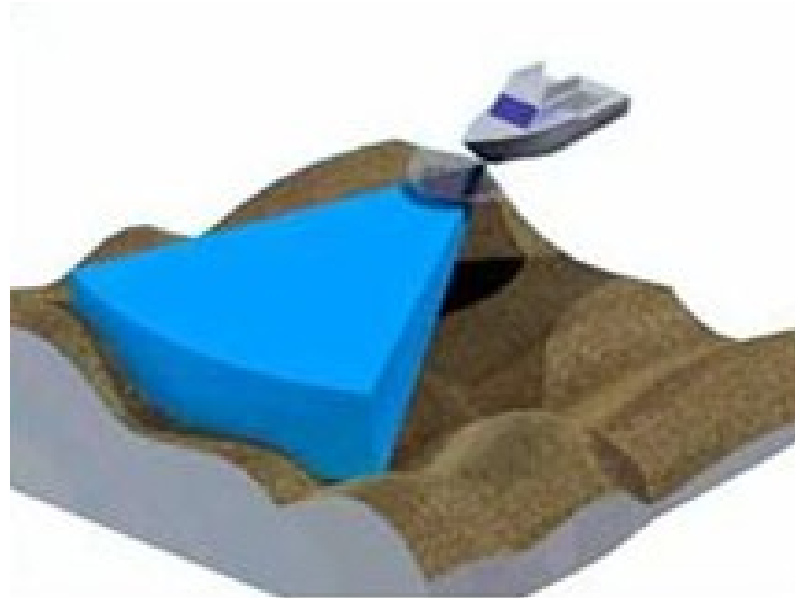
Base principle



# Acoustics

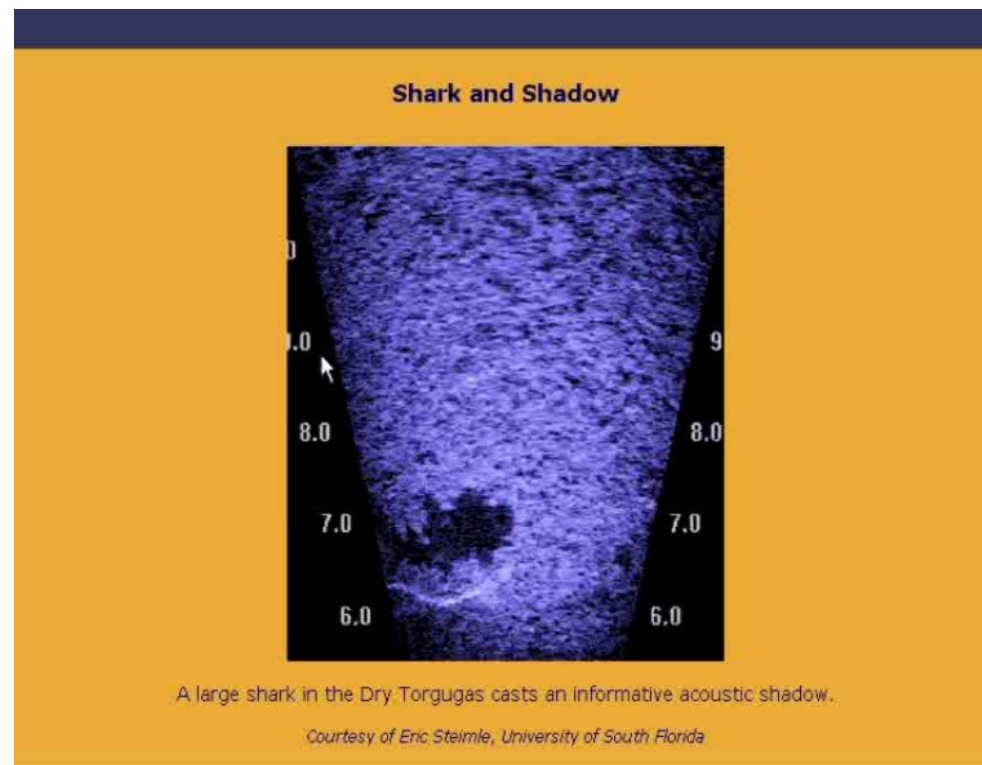
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## Frontal sonar



# Acoustics

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# Acoustics

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Passive

The source may be anything



Whales



Submarines

# Acoustics

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How far I'll go ?

How far do Whalesongs travel ?

Over 3000 km ! (1900 miles)

# Acoustics

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## Pros / Cons

- + Low frequency (1 kHz - 100 KHz) = Good ranges (up to 10km)
- + Can be passive
- Slower than LIDAR/RADAR

# Introduction to YOLO for object detection

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# YOLO

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What is it ?

You Only Look Once

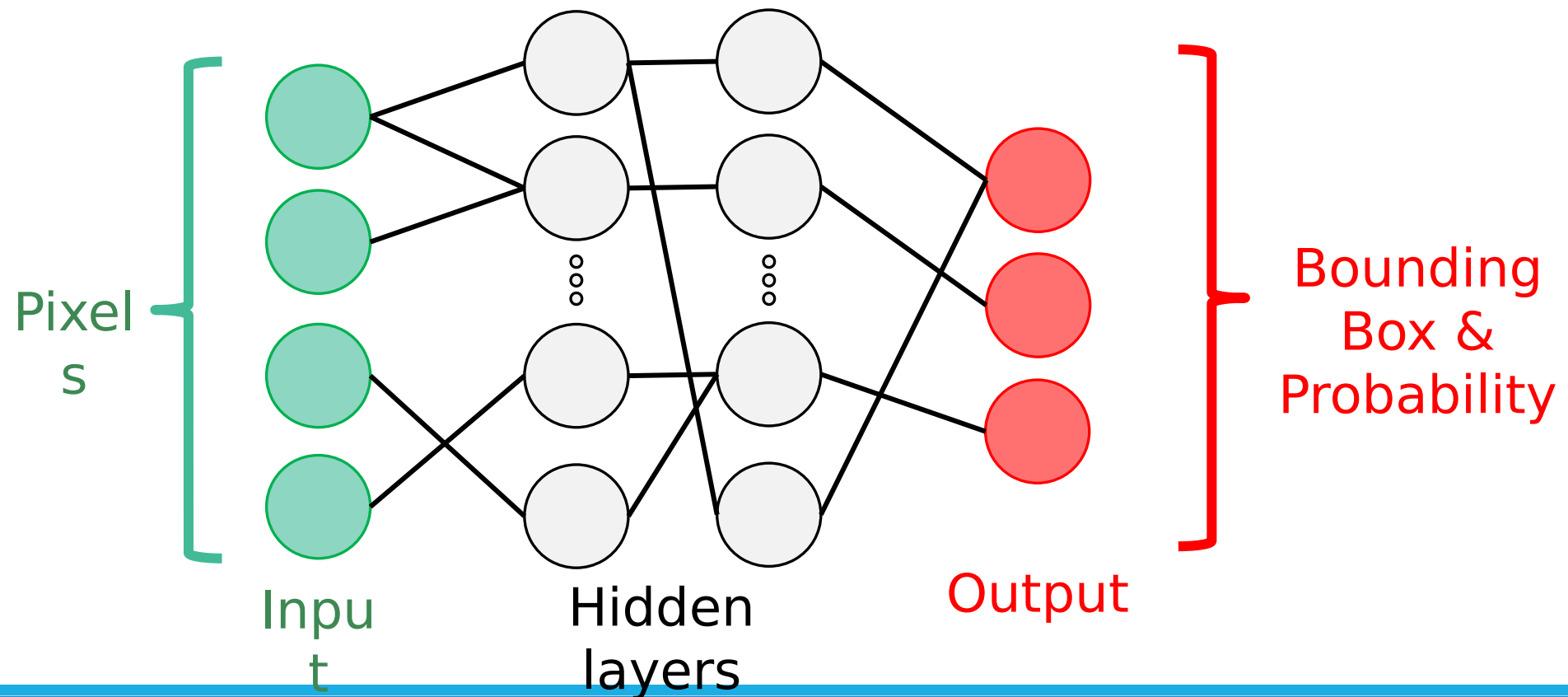
AI and Computer Vision

Simultaneous object detection and classification



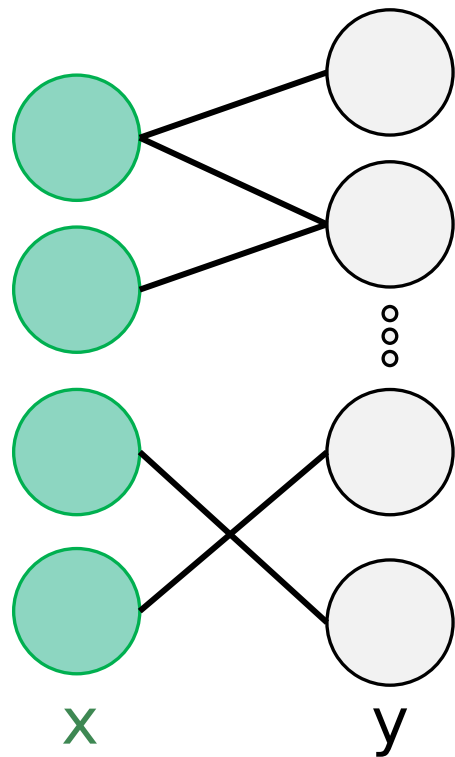
# YOLO

## Convolutional neural network (CNN)

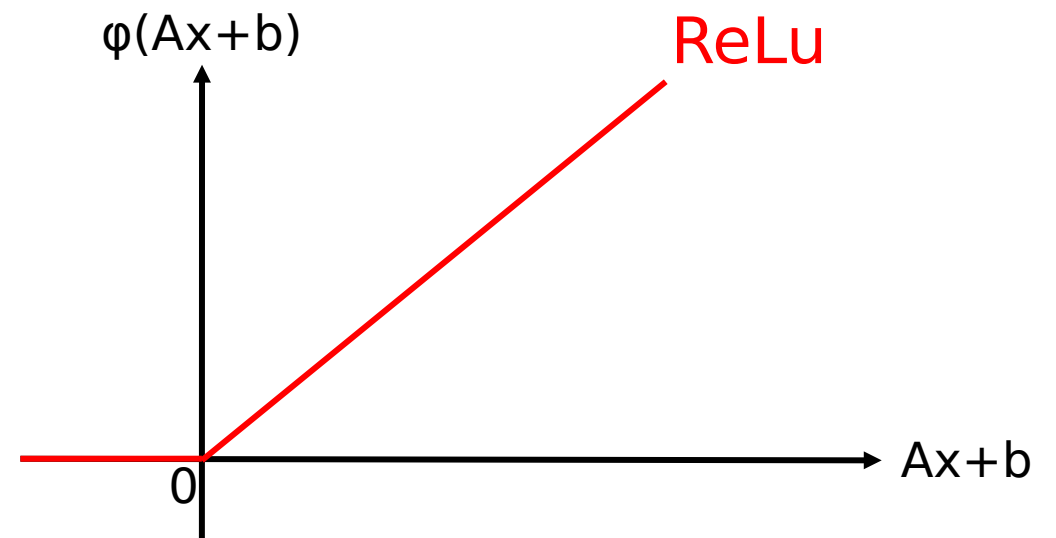


# YOLO

## A Layer

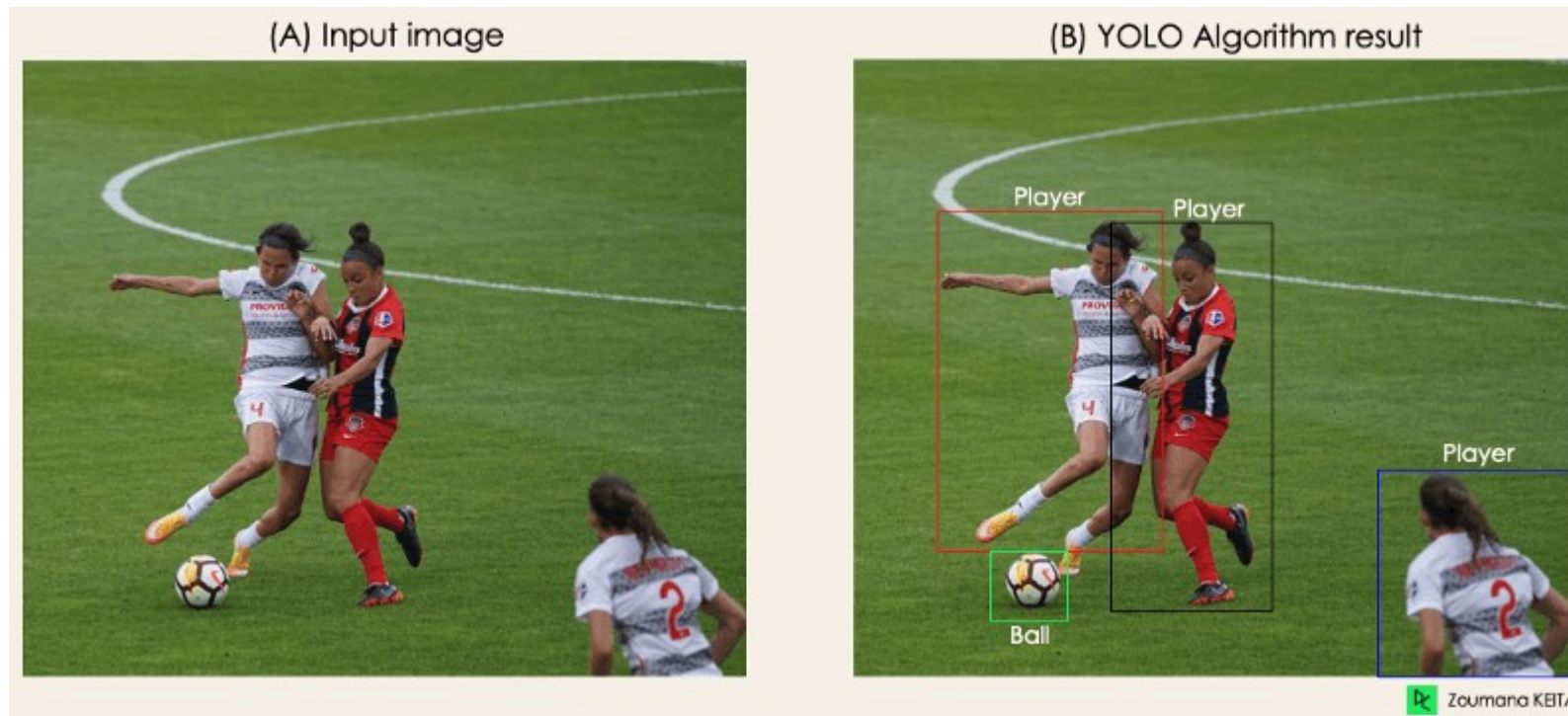


For each layer :  
 $y = \varphi(Ax + b)$



# YOLO

## Result



# Questions ?

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Now some practice  
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