Pedestrian tracking

VUT FIT POVa

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Task Inspiration

- Marauder's Map from Harry Potter
  - Magic parchment that reveals the current location of anyone on Hogwarts grounds

http://harrypotter.wikia.com/wiki/Marauder%27s_Map

Task definition

1. Multiple people walking in a scene
2. Multiple stationary cameras
   - ✓ Initial calibration
3. Individual path tracking

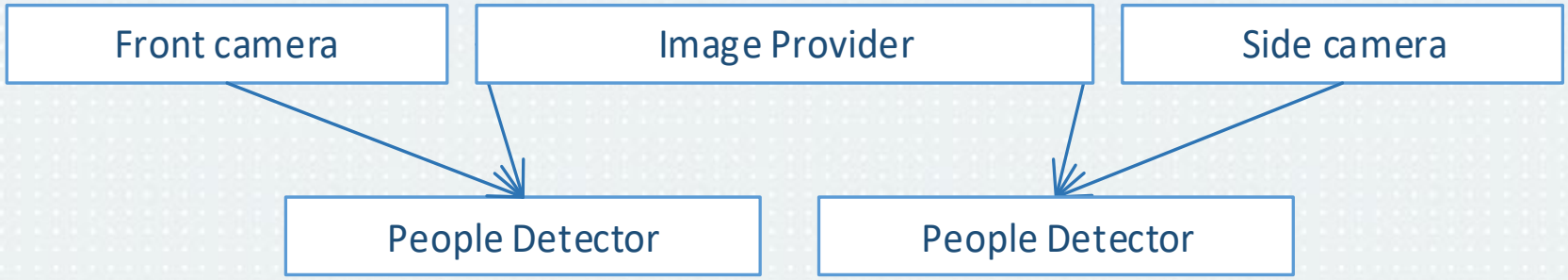
Processing pipeline

Front camera

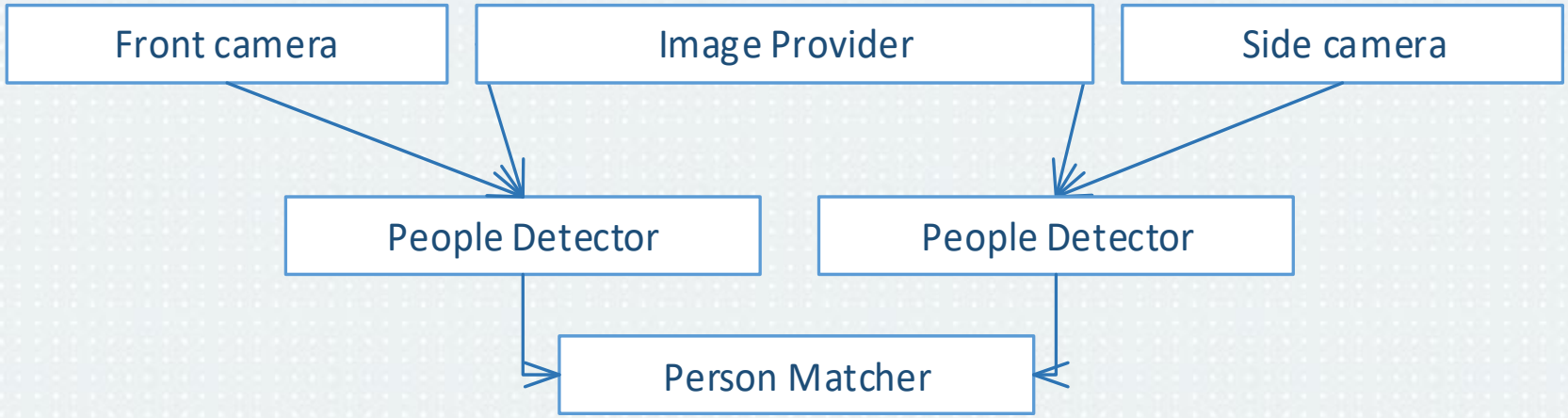
Side camera

Processing pipeline

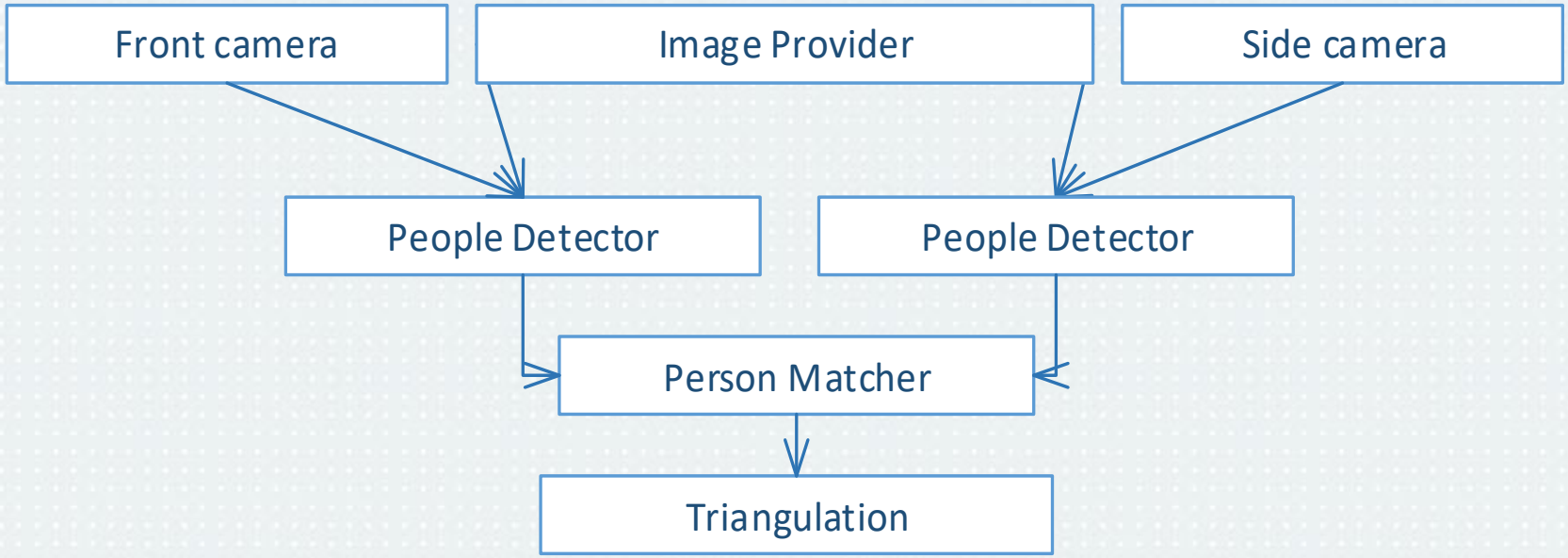
Processing pipeline



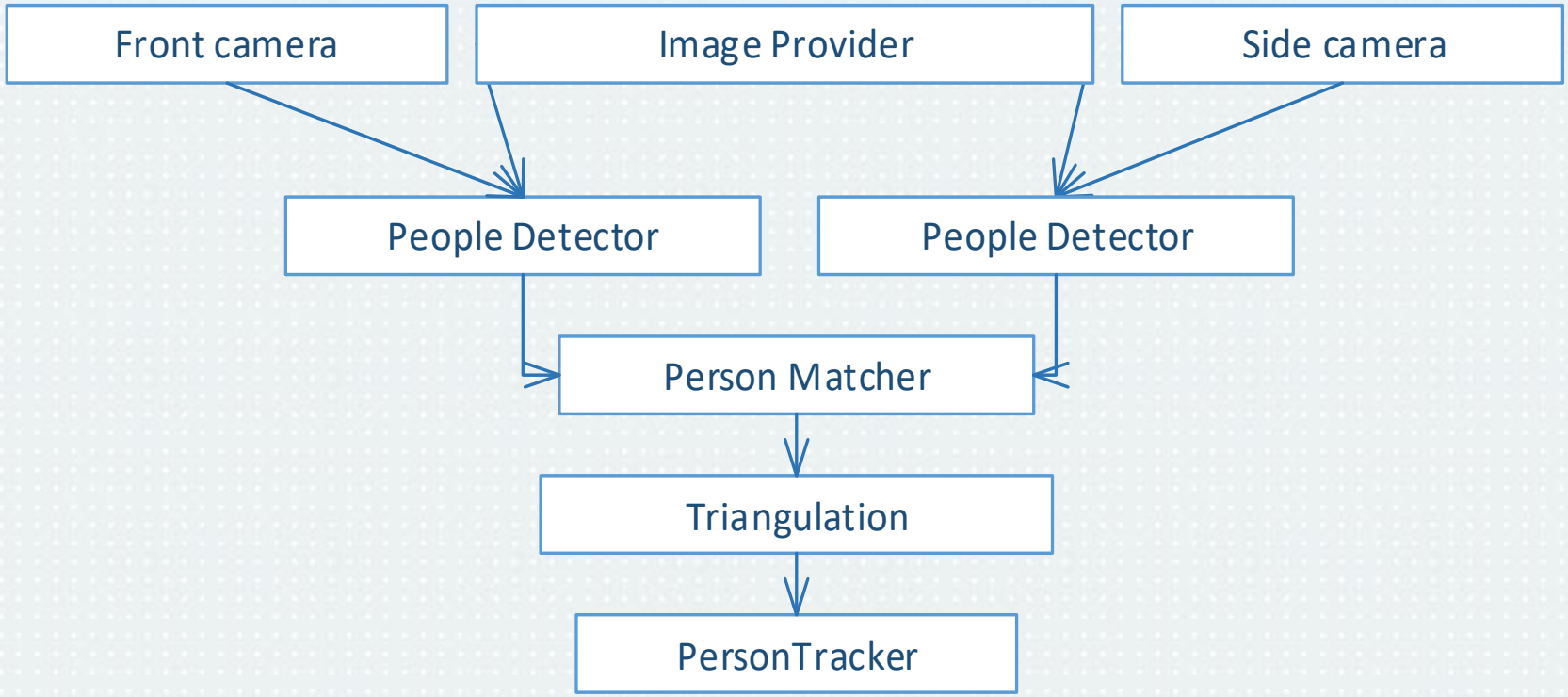
Processing pipeline



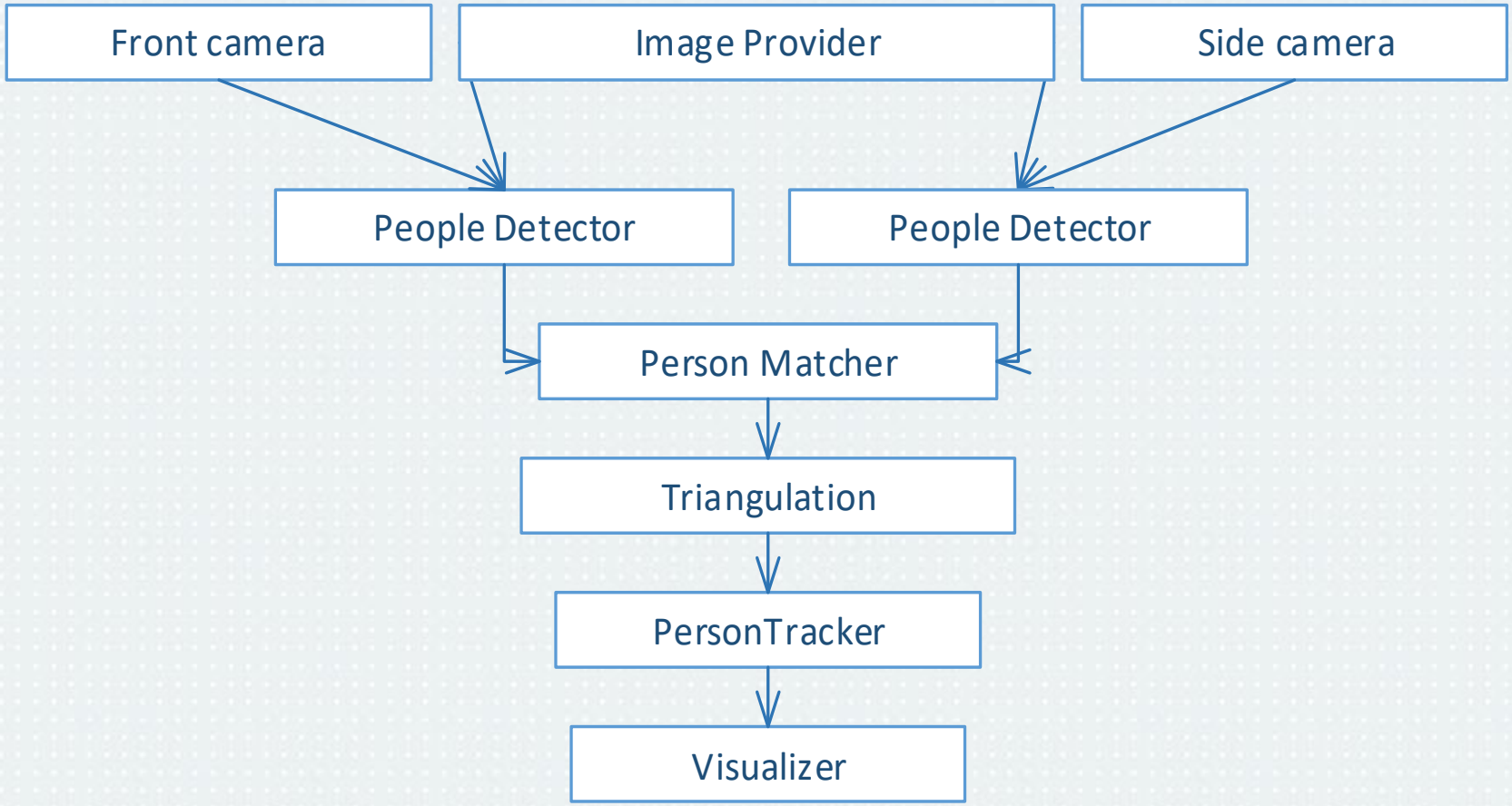
Processing pipeline



Processing pipeline

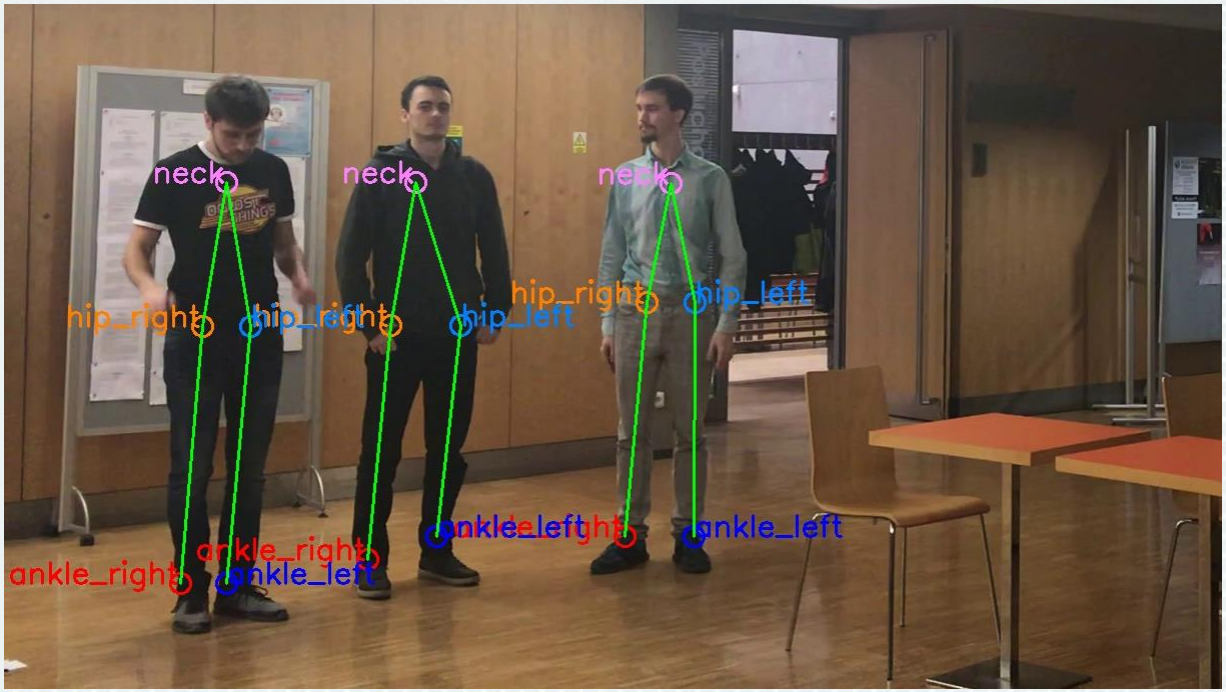


Processing pipeline



Human Detection in 2D

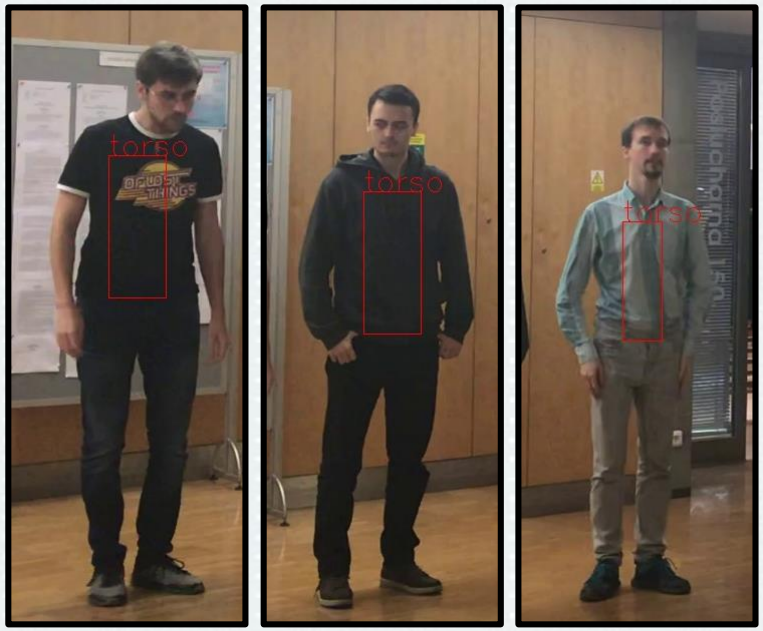
- *OpenPose* deep neural network
- Pretrained model with *COCO* dataset



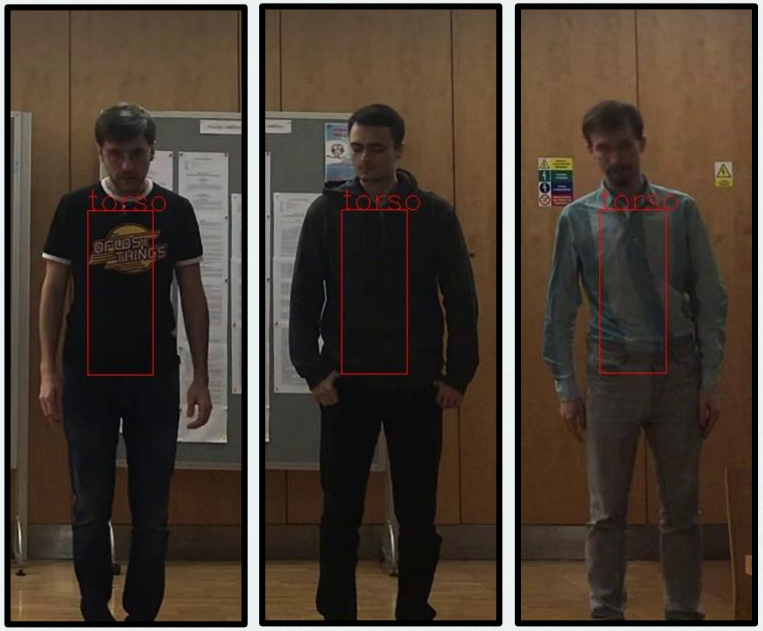
Multi-person key point detection

Person View Matching

Similar torso histograms → same person



Side person views

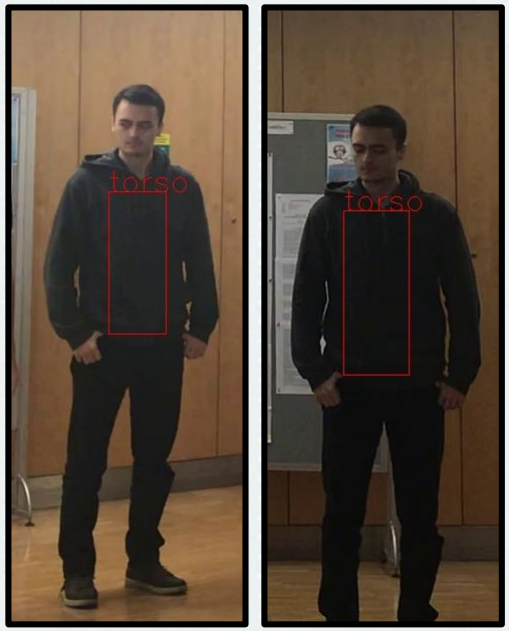


Front person views

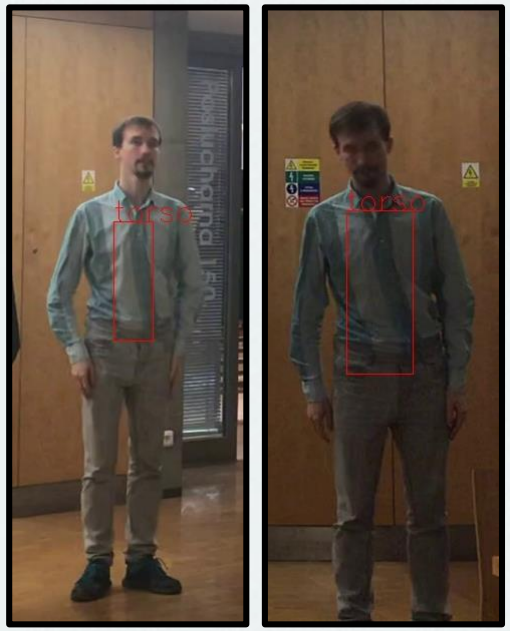
Person View Matching

Similar torso histograms → same person

PersonTimeFrame A



PersonTimeFrame B

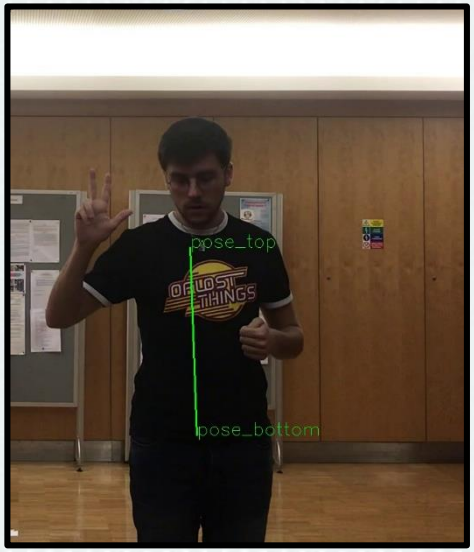


PersonTimeFrame C

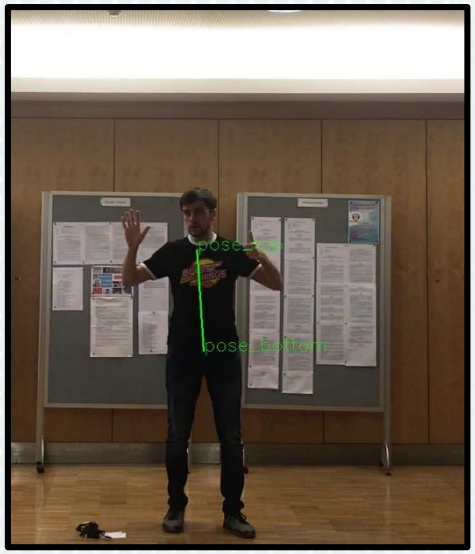
Triangulation

Average person's torso → distance from camera

$y = 2$ m



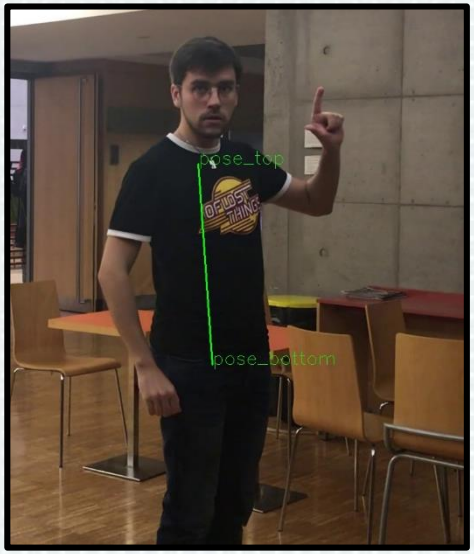
$y = 3$ m



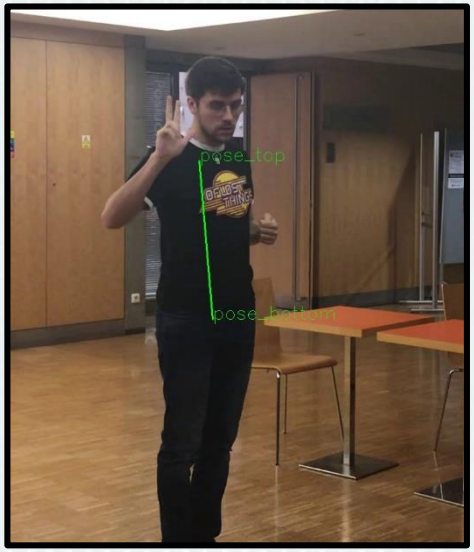
$y = 6$ m

Triangulation

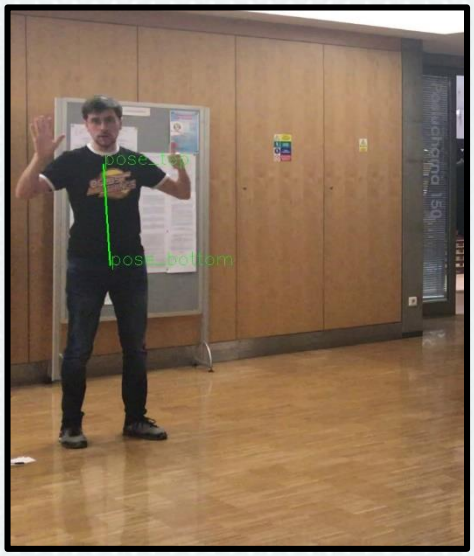
Average person's torso → distance from camera



$y = 2$ m



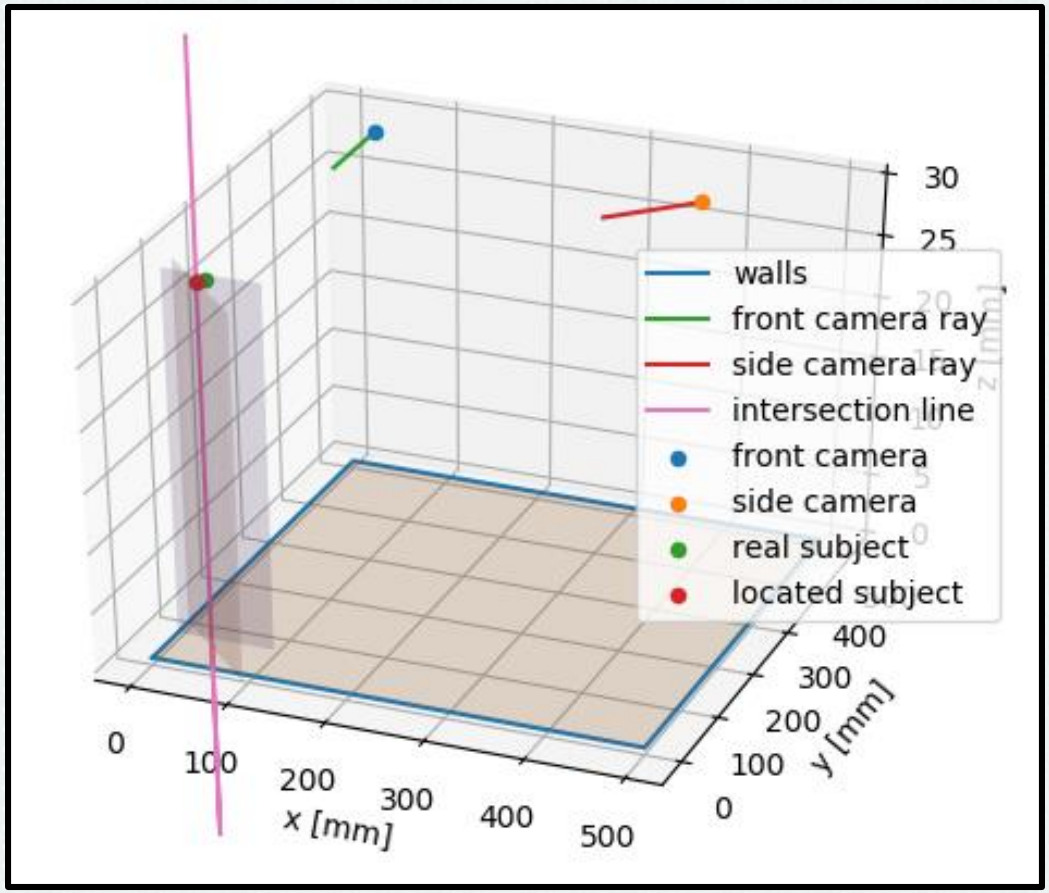
$y = 3$ m



$y = 6$ m

Triangulation

Intersection of distance planes → person‘s position



Person Tracking

Similar torso histograms *over time* → same person

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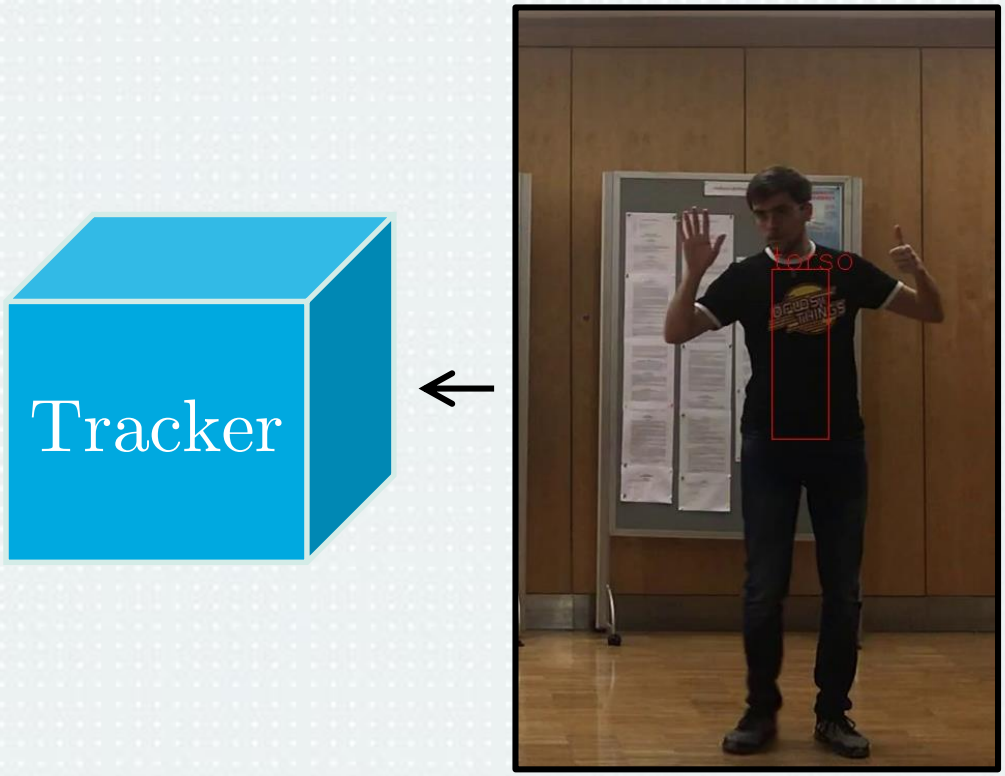
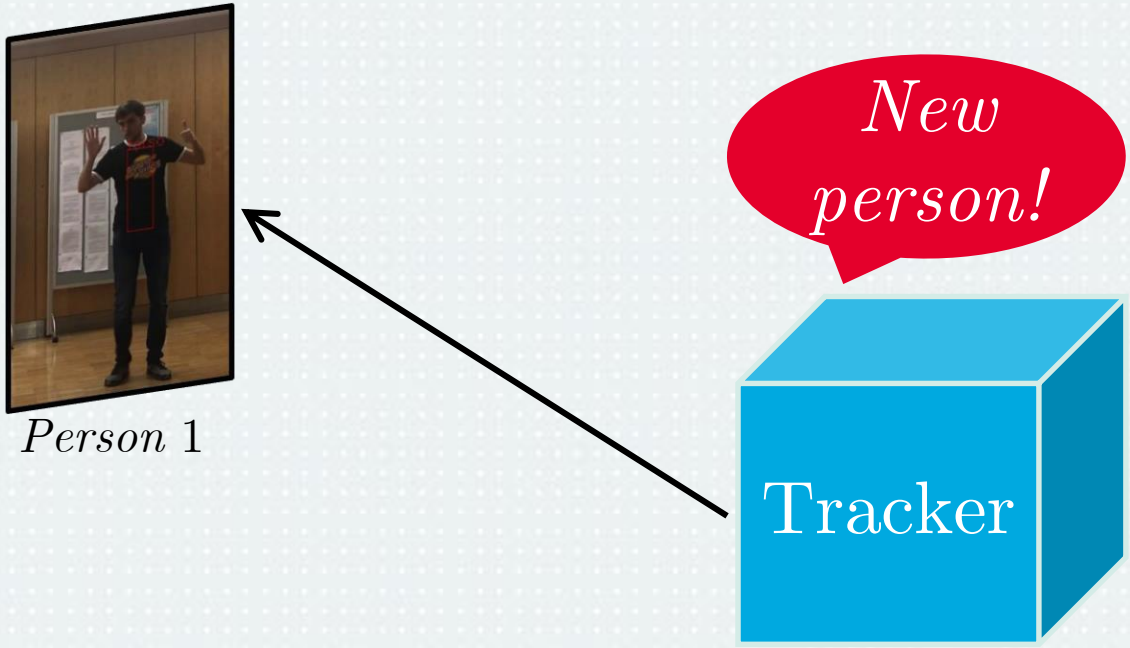


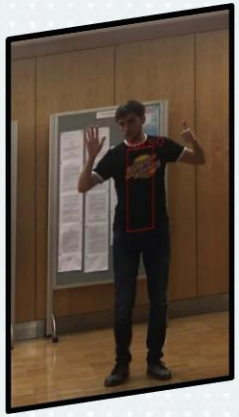
Person Tracking

Similar torso histograms *over time* → same person



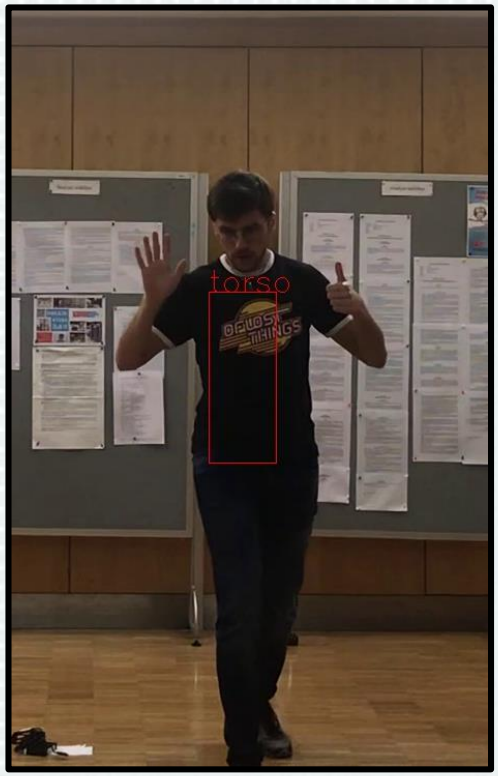
Person Tracking

Similar torso histograms *over time* → same person



Person 1

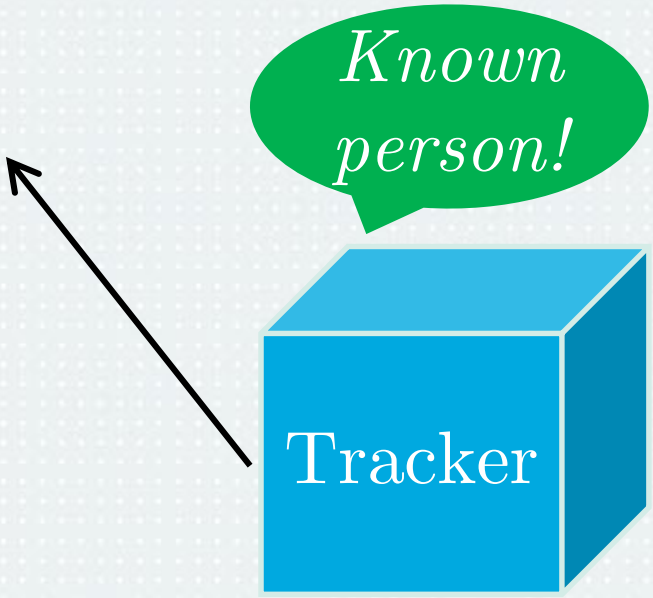
Tracker



Person Tracking

Similar torso histograms *over time* → same person

Person 1



Person Tracking

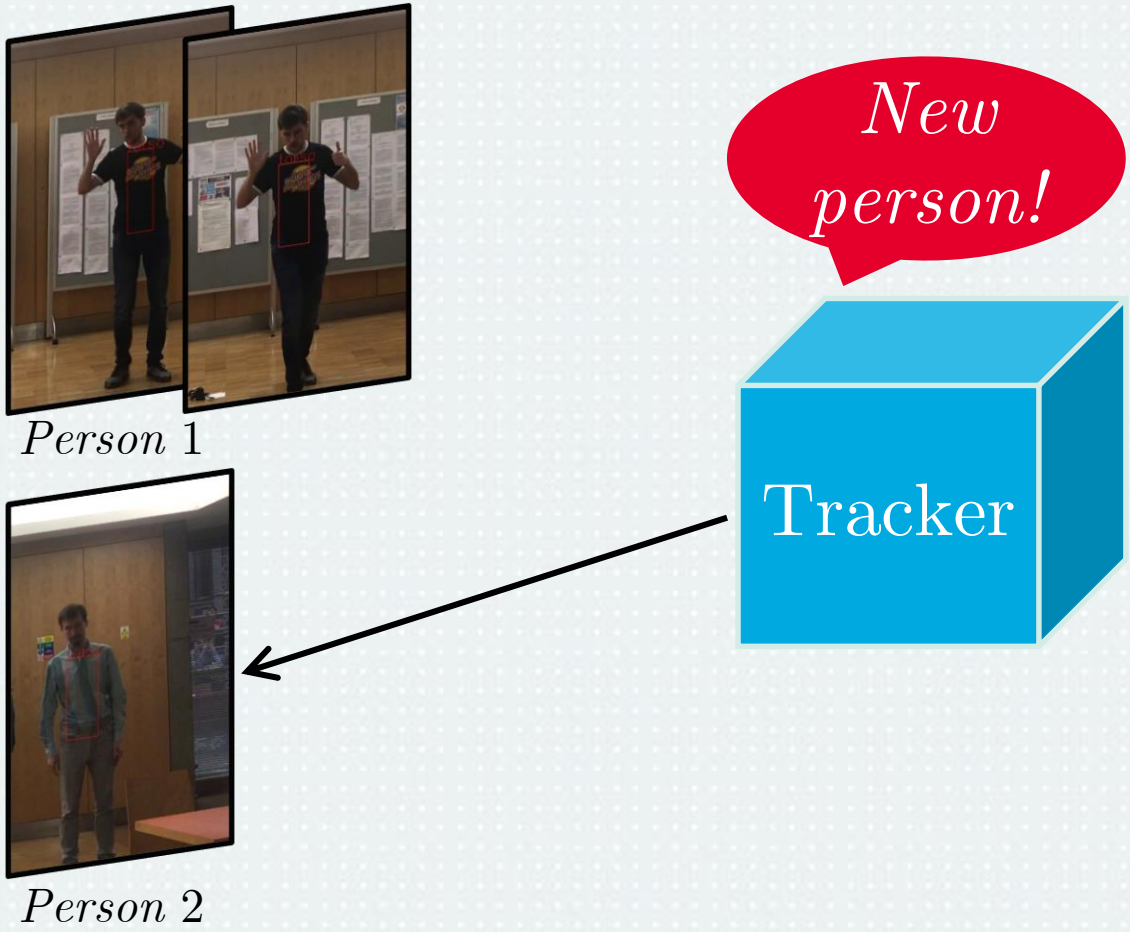
Similar torso histograms *over time* → same person

Person 1

Tracker

Person Tracking

Similar torso histograms *over time* → same person



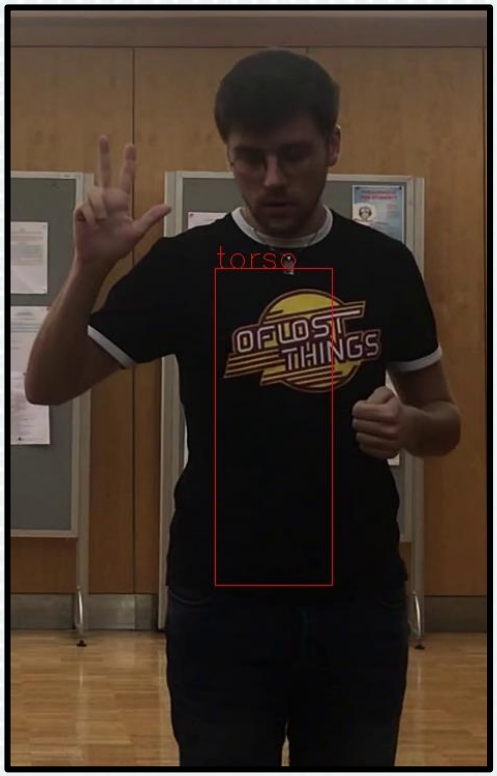
Person Tracking

Similar torso histograms *over time* → same person

Person 1

Person 2

Tracker



Person Tracking

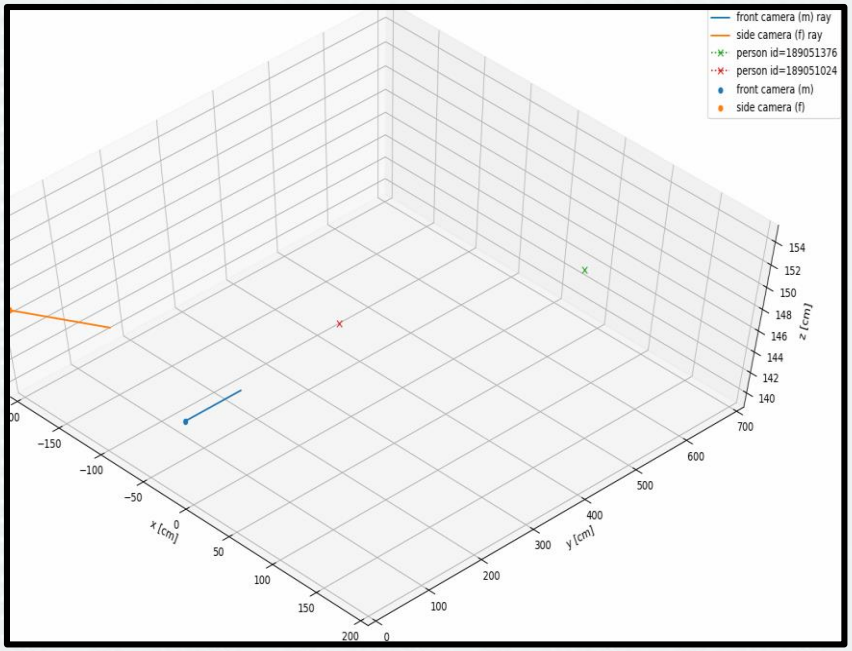
Similar torso histograms *over time* → same person

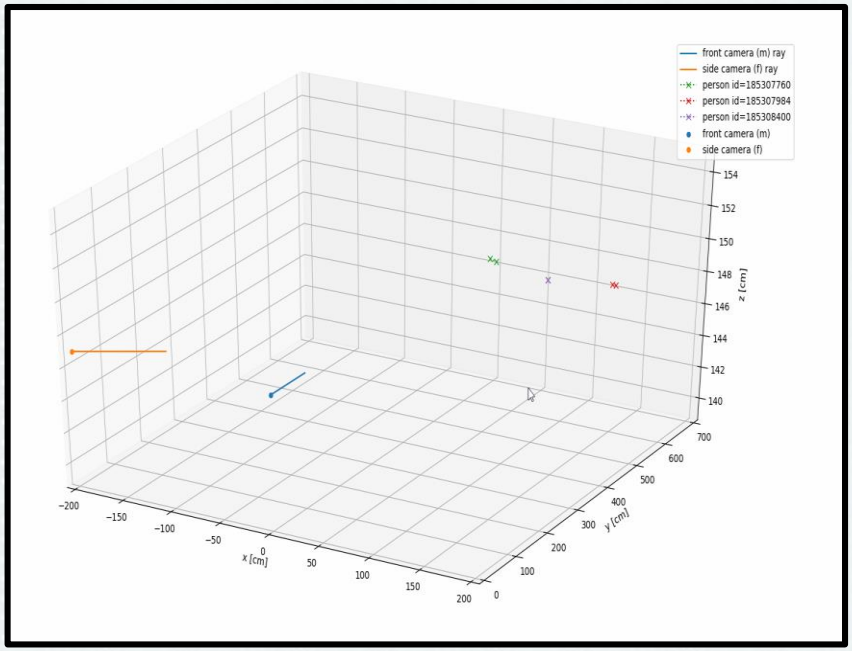
Person 1

Person 2

Visualisation

- Paths of all tracked people, positions of cameras
- Interactive 3D model

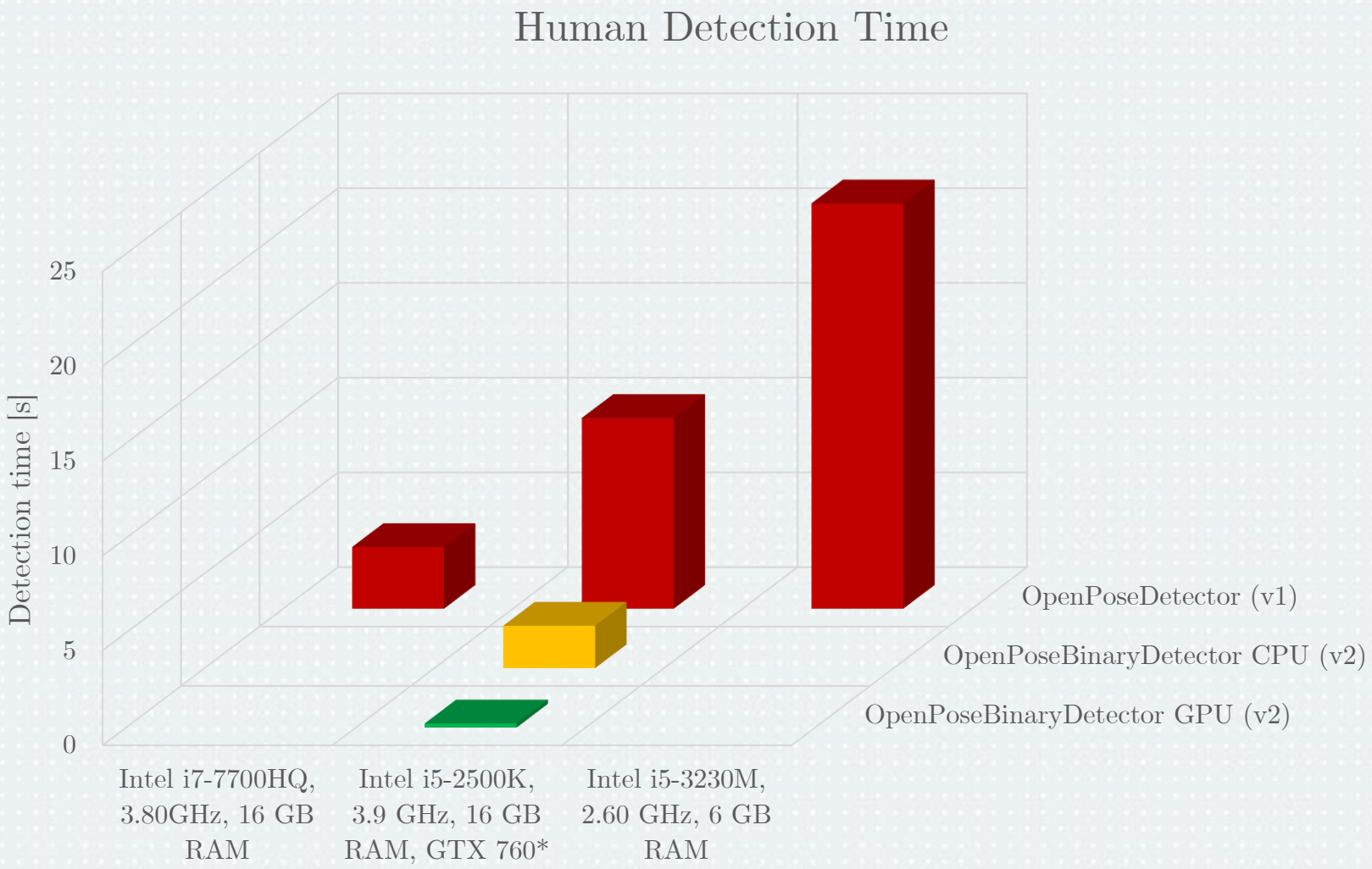




Testing Data

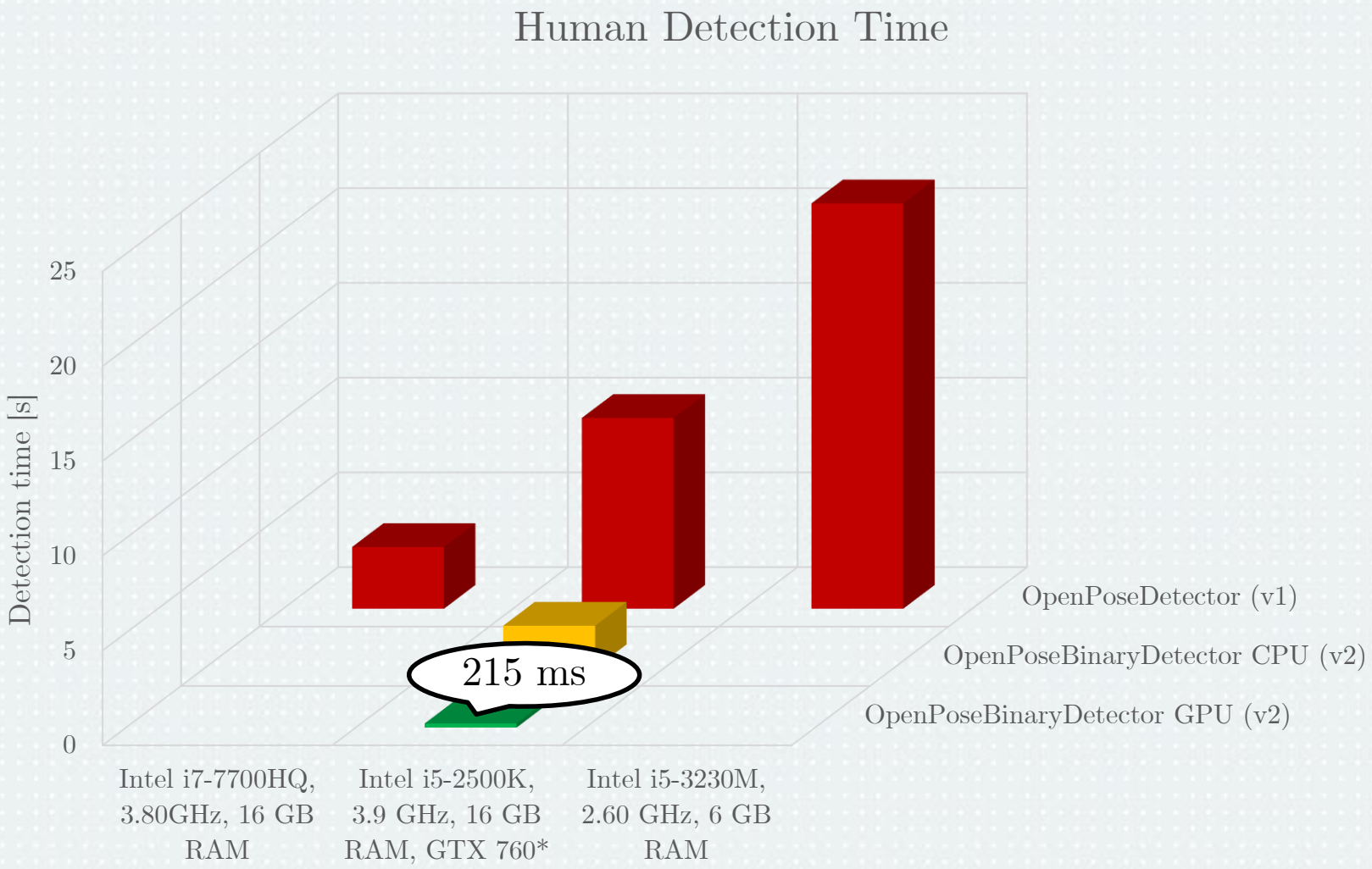
- Own images and videos
- *COCO* dataset for *OpenPose*

Evaluation



* GPU binary start-up time: 2.1 s, CPU binary start-up time: 3.4 s.

Evaluation



* GPU binary start-up time: 2.1 s, CPU binary start-up time: 3.4 s.

Evaluation

Image preprocessing → stable matcher and tracker

Side original

Front original

Evaluation

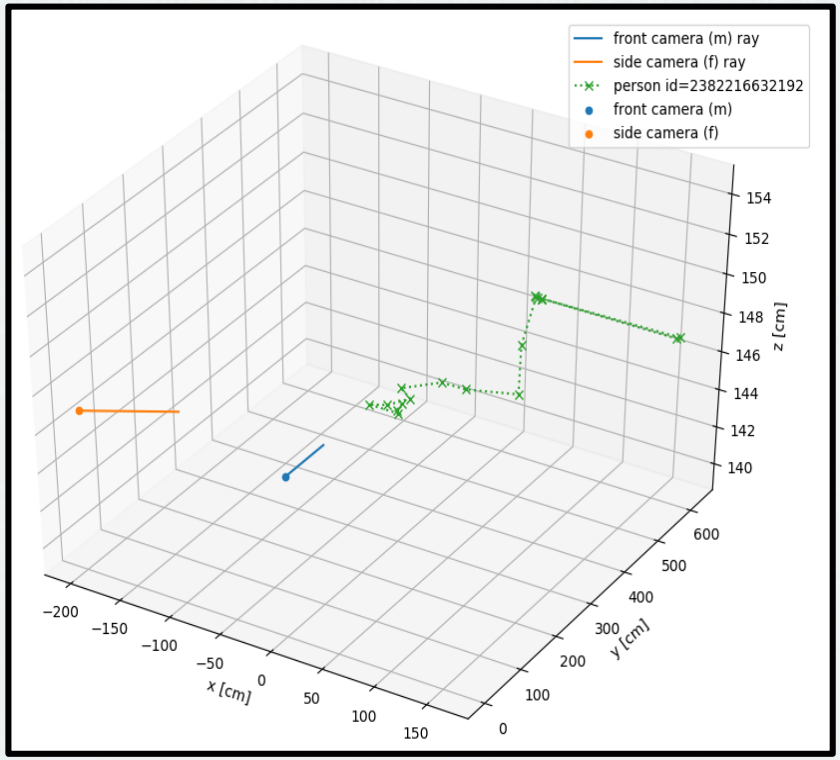
Image preprocessing → stable matcher and tracker

Side preprocessed

Front preprocessed

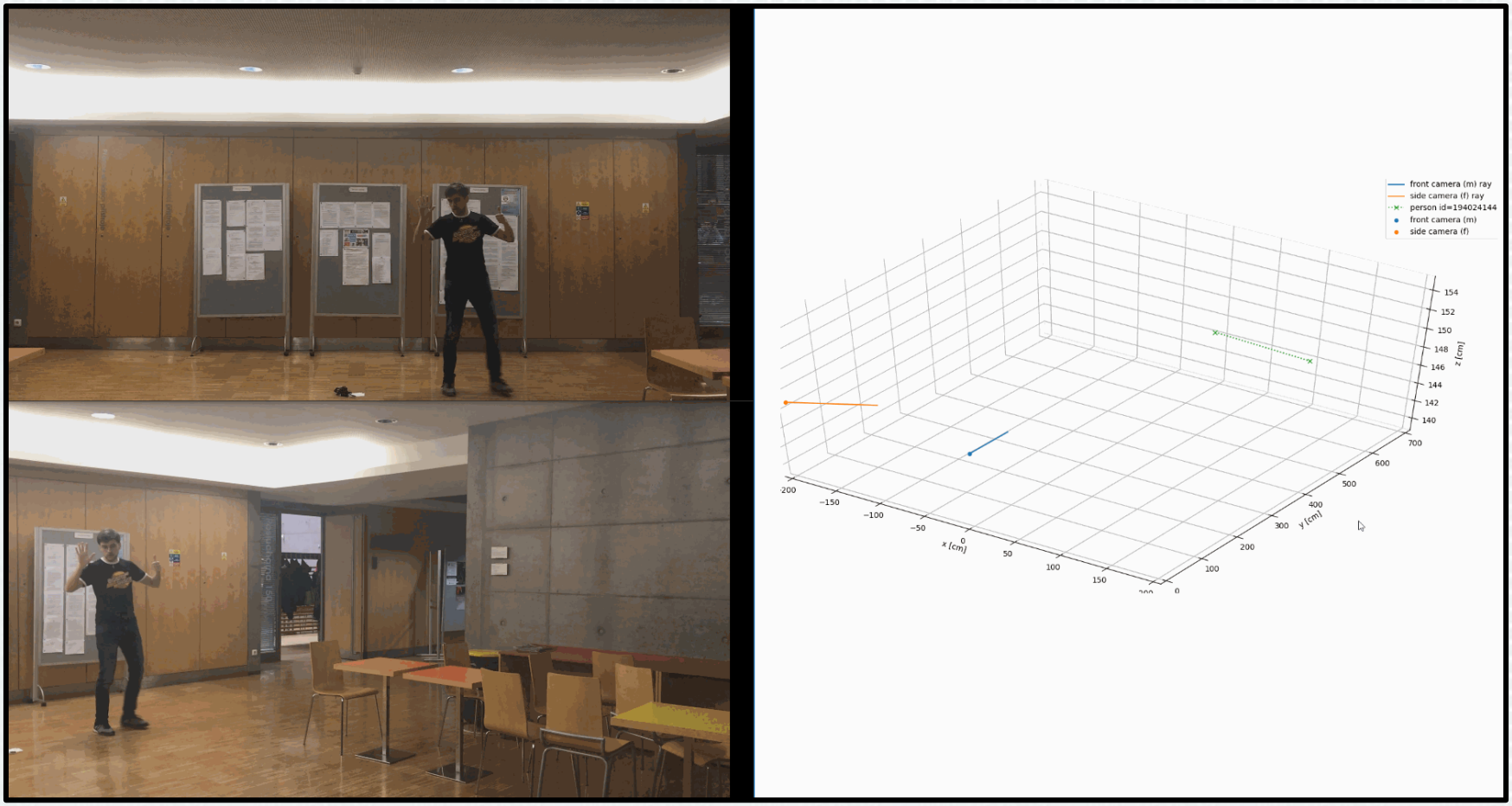
Evaluation

- **Matching**
  torso (t-shirt) based
- **Triangulation**
  worst case less than 35 cm error in 600 cm space.
- **Tracking**
  similarity threshold



Pedestrian tracking

Thank you for your attention.



Speeded up for illustration.