



Safe and Capable Robots

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ÉTS

Le génie pour l'industrie



McGill



HALODI
robotics



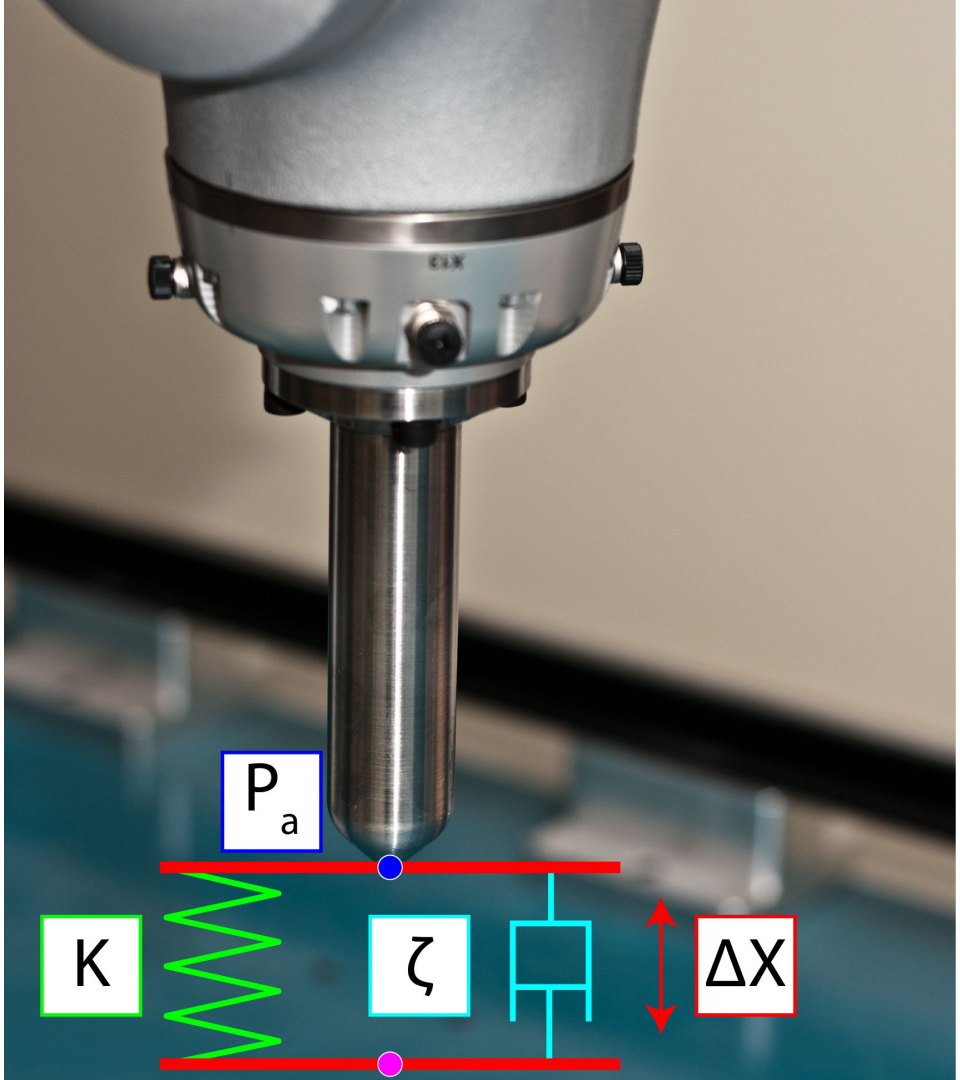
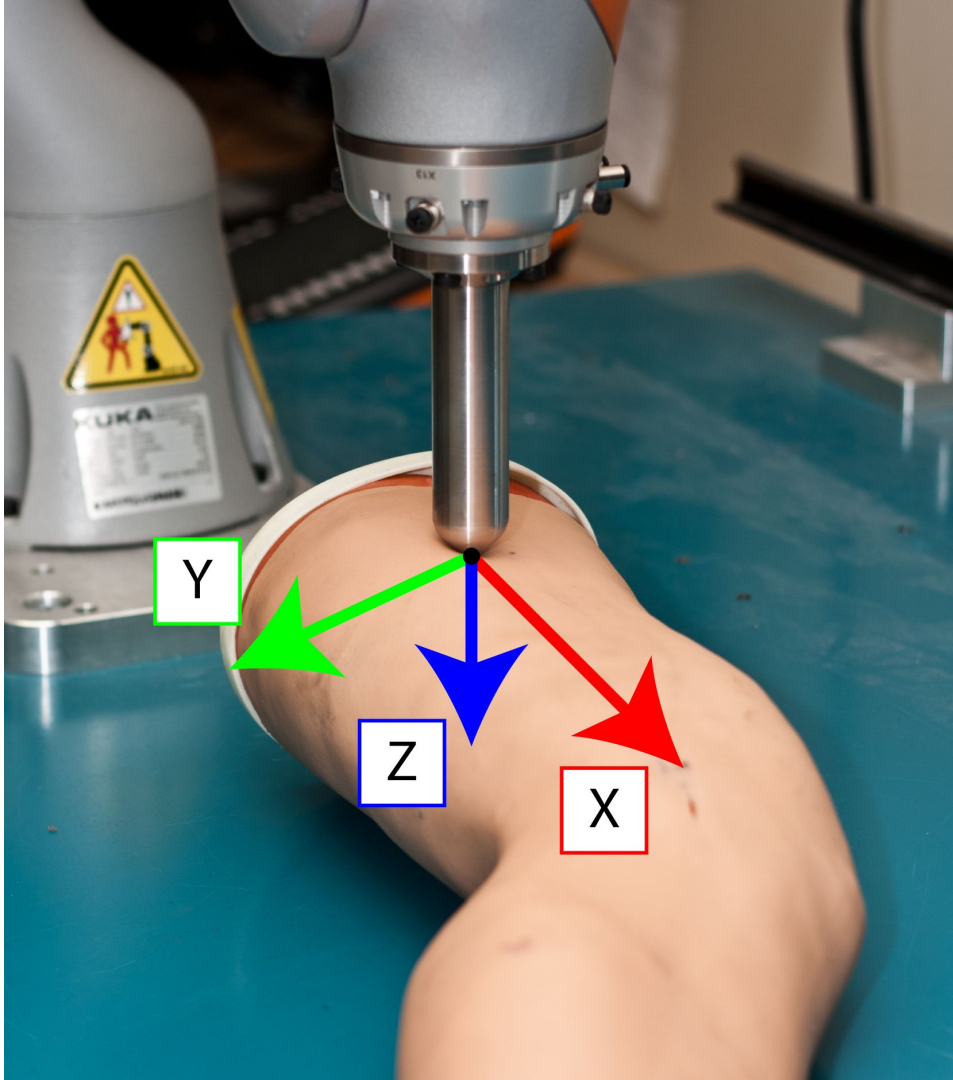
FounderFuel
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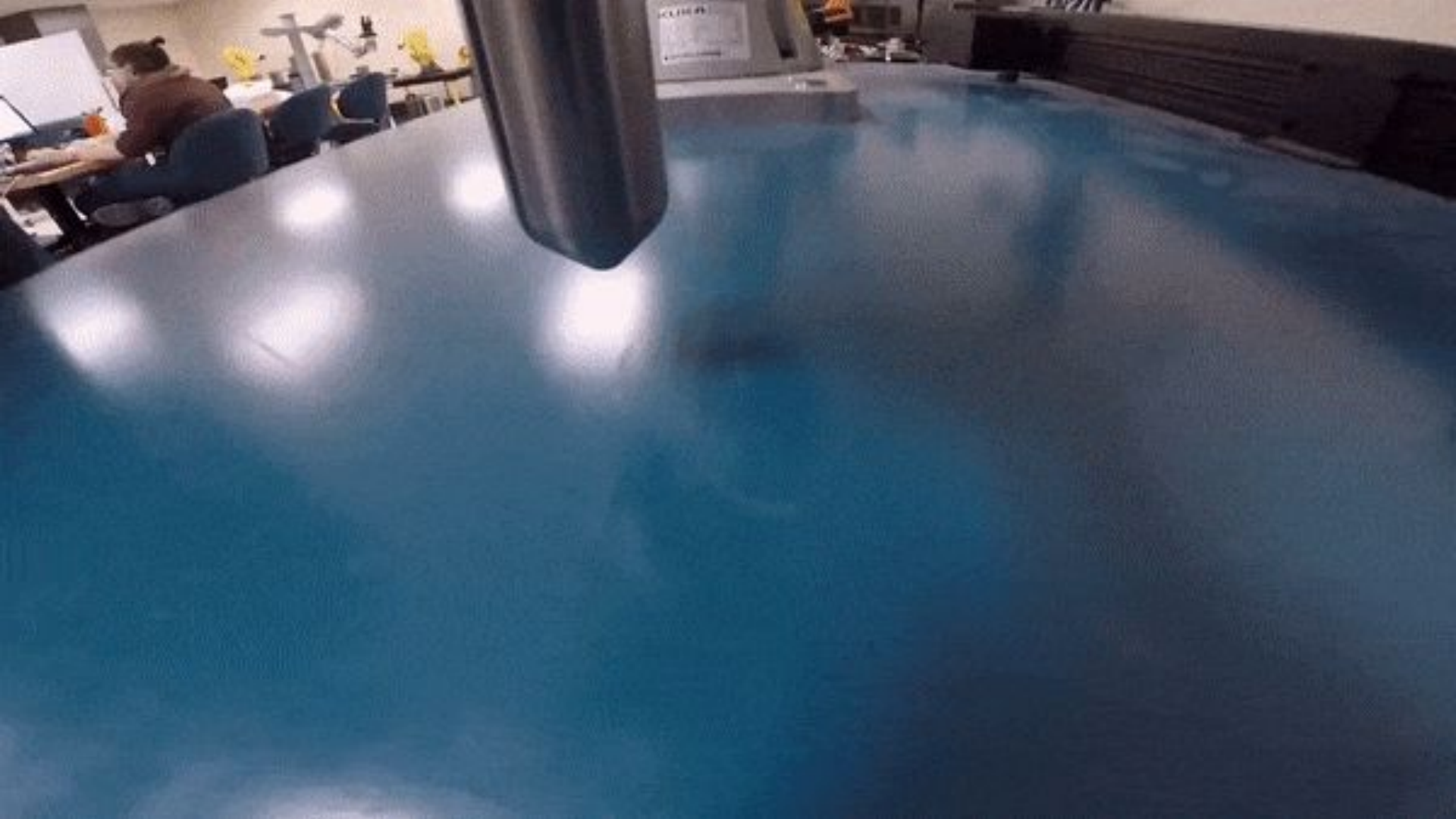


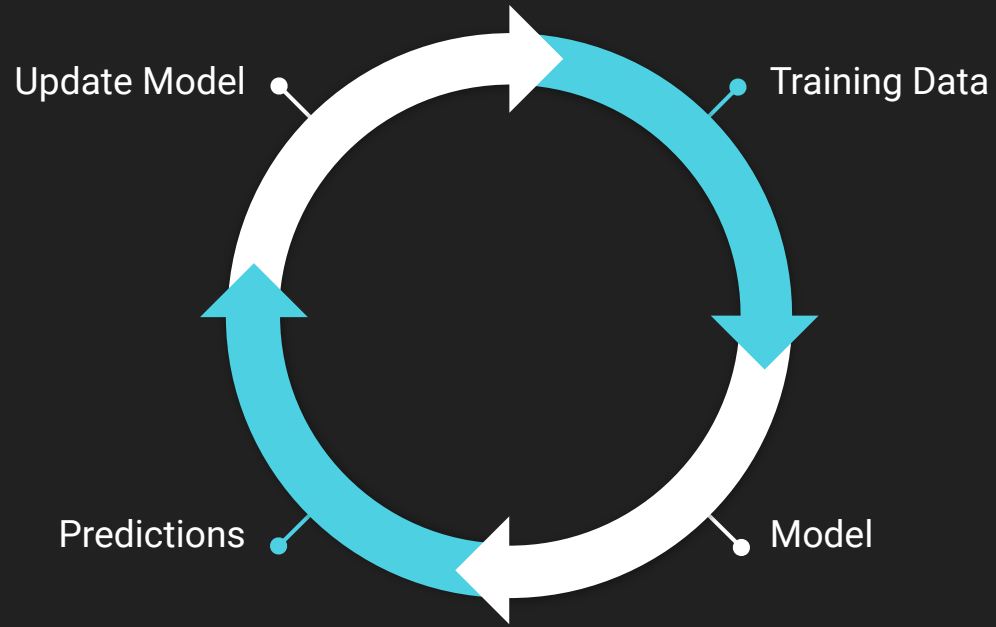
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robotics

**How do we make physical
human-robot interaction safe?**





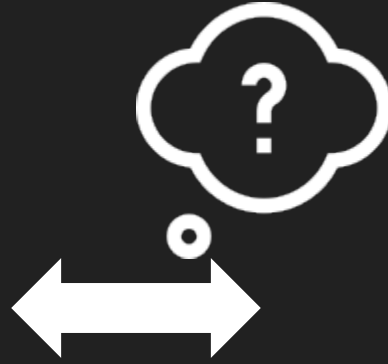








Data Processing
& ML



Robot Controller



gRPC



```
syntax = "proto3";

service RobotService {
    rpc Move (Joints) returns (SessionResult) {
    }
}

message SessionResult {
    int32 status = 1;
}

message Joints {
    repeated double joints = 1;
}
```

```
import grpc
from robot_control_pb2_grpc import RobotStub

class ControllerClient:
    def __init__(self) -> None:
        self.stub = None
        self.channel = None
        self.host = "172.31.1.147"
        self.port = 30000

    def connect(self):
        self.channel = grpc.insecure_channel(f"{self.host}:{self.port}")
        self.stub = RobotStub(self.channel)
```

```
from controller_client import ControllerClient
from robot_control_pb2 import SessionResult
from scipy.optimize import differential_evolution

client = ControllerClient()

def cb_objective(x):
    """Objection function callback"""
    session_result = client.stub.RunSession(x) # type: SessionResult
    session_value = evaluate_result(session_result) # type: float
    return value

# connect to robot
client.connect()

# run optimization
result = differential_evolution(cb_objective, bounds)
```





(1) Initialize Population



(4) Evaluate Fitness



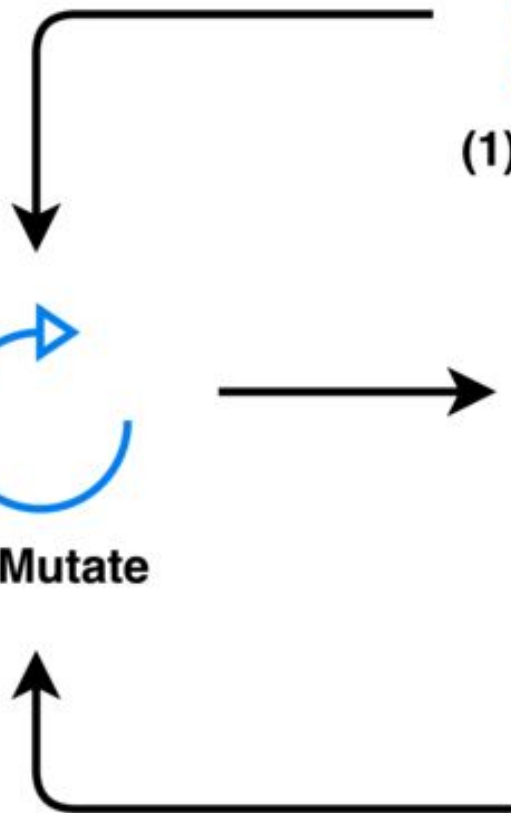
(3) Crossover

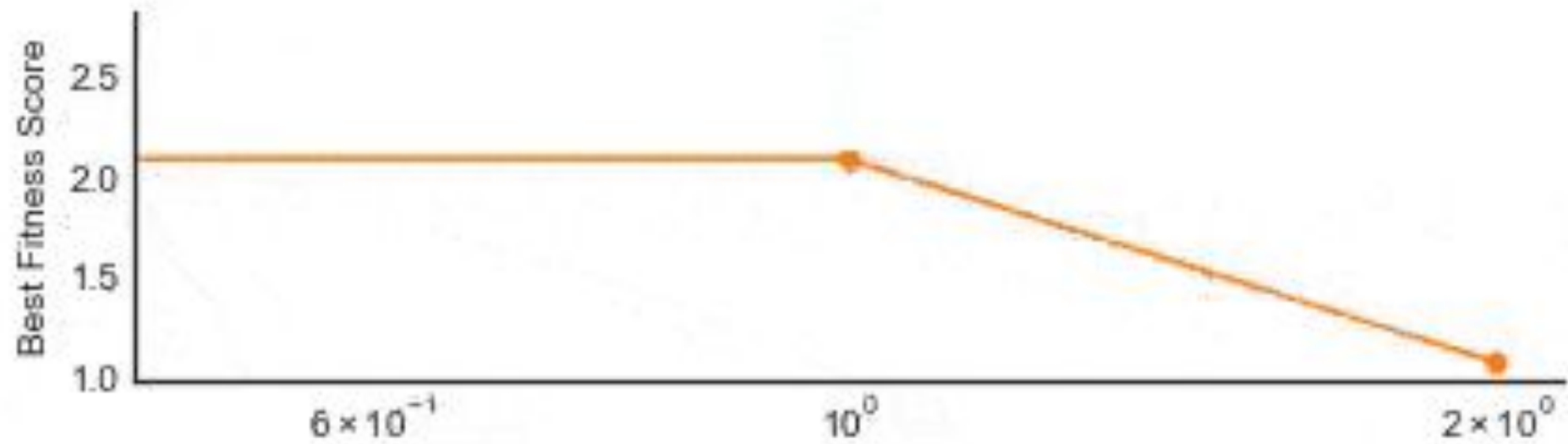
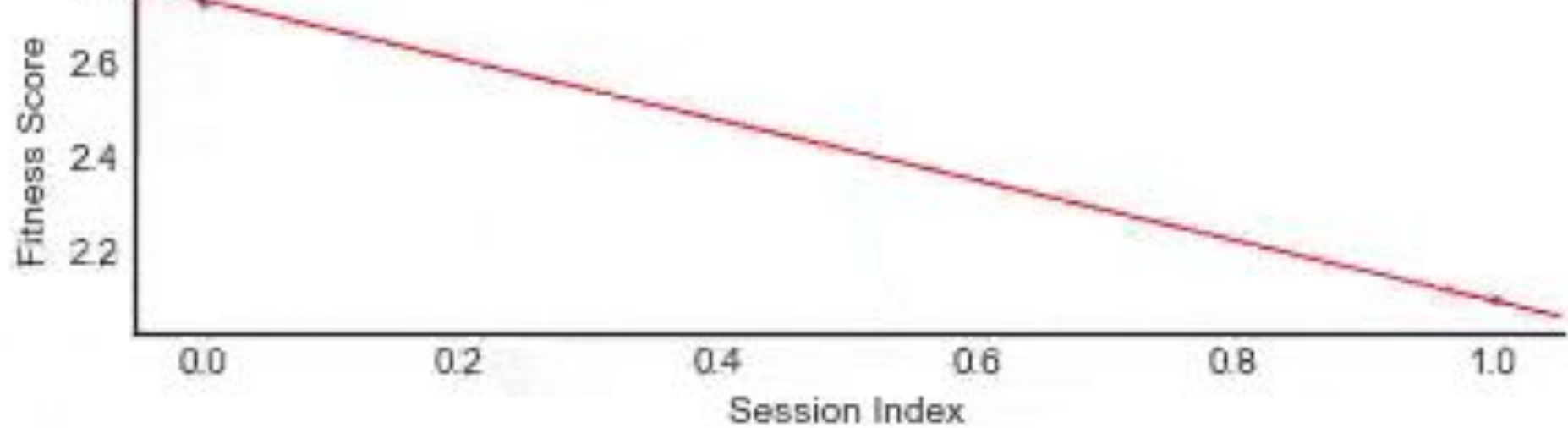


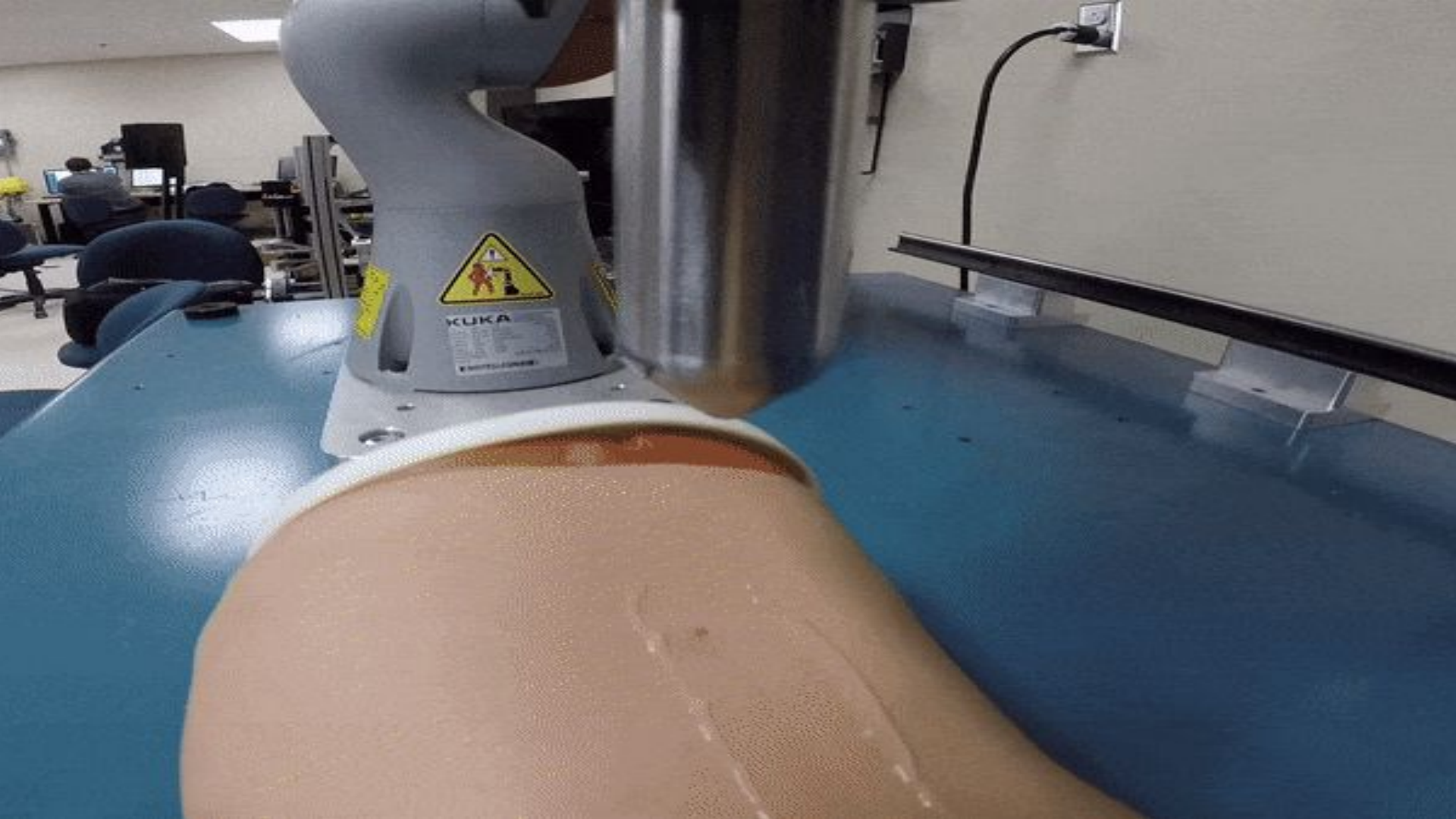
(5) Update Population



(2) Mutate









```
syntax = "proto3";
```

```
service RobotService {
```

```
    rpc Poke (SessionSettings) returns (SessionResult) {
```

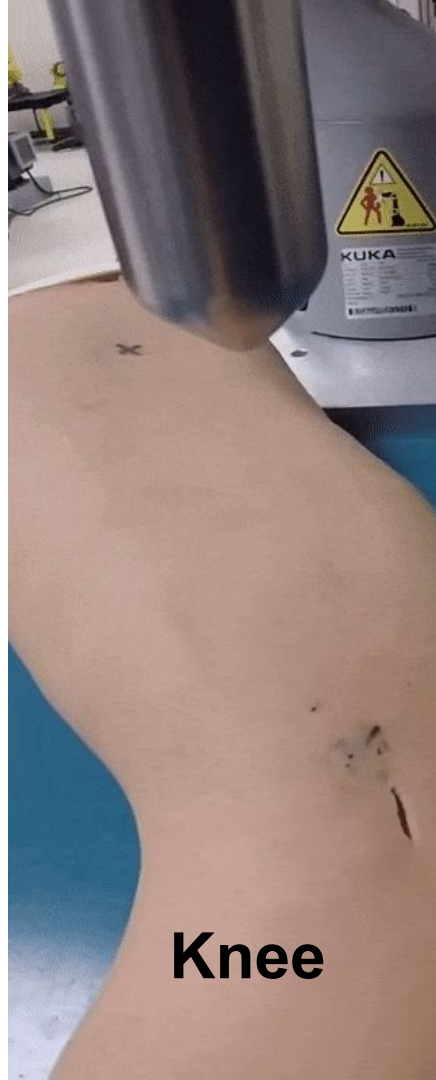
```
    }
```



What was involved in
the contact event?



Thigh



Knee



Calf



Ankle

POKE!



TRAINING
DATA



gRPC



OK, I'LL MOVE
NOW.

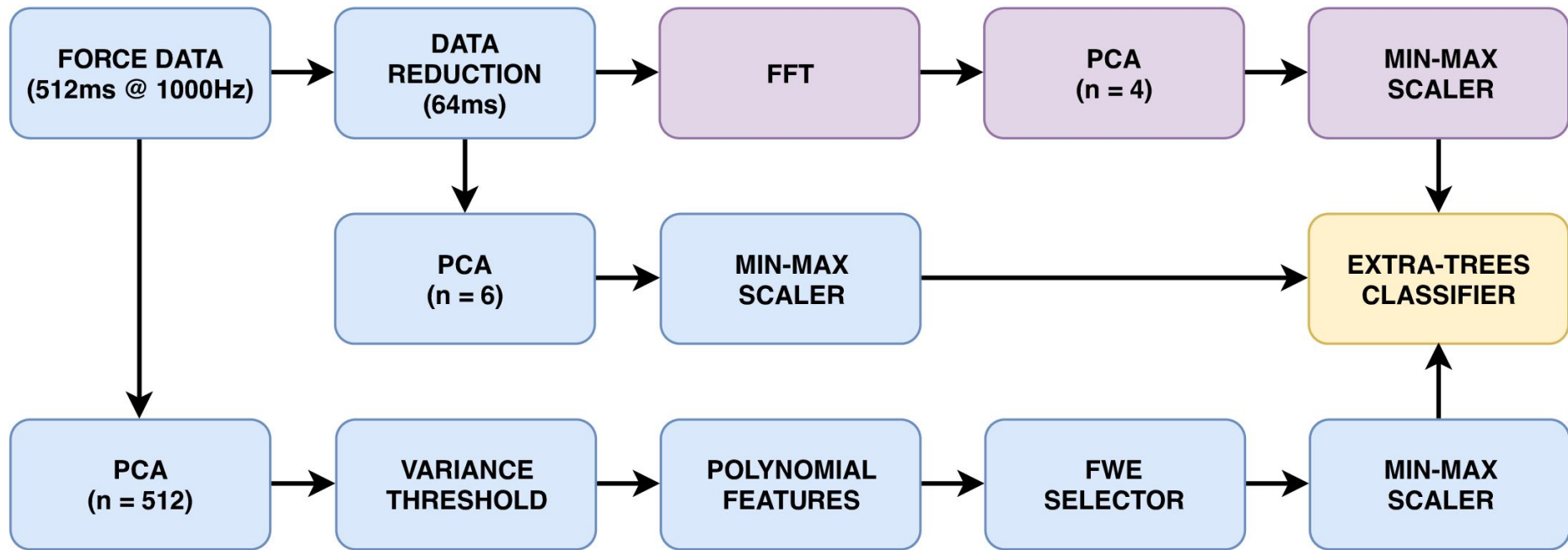


SENSOR
DATA



gRPC





```
import pandas as pd
from sklearn.decomposition import PCA
from sklearn.ensemble import ExtraTreesClassifier
from sklearn.feature_selection import SelectFwe, VarianceThreshold
from sklearn.pipeline import make_pipeline, make_union
from sklearn.preprocessing import MinMaxScaler, PolynomialFeatures

df = pd.read_csv("training-data.csv")
x, y = split_features_labels(df)

pipeline = make_pipeline(
    make_union(
        make_pipeline(
            Reducer(64), FFT(), PCA(n_components=4), MinMaxScaler(),
        ),
        make_pipeline(
            Reducer(64), PCA(n_components=6), MinMaxScaler(),
        ),
        make_pipeline(
            PCA(), VarianceThreshold(), PolynomialFeatures(),
            SelectFwe(), MinMaxScaler(),
        ),
    ),
    ExtraTreesClassifier(),
)
pipeline.fit(x, y)
```



MOVE HERE!



gRPC



POINT THERE!



gRPC



FEED ME DATA!



gRPC

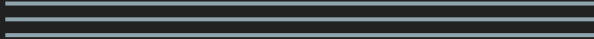
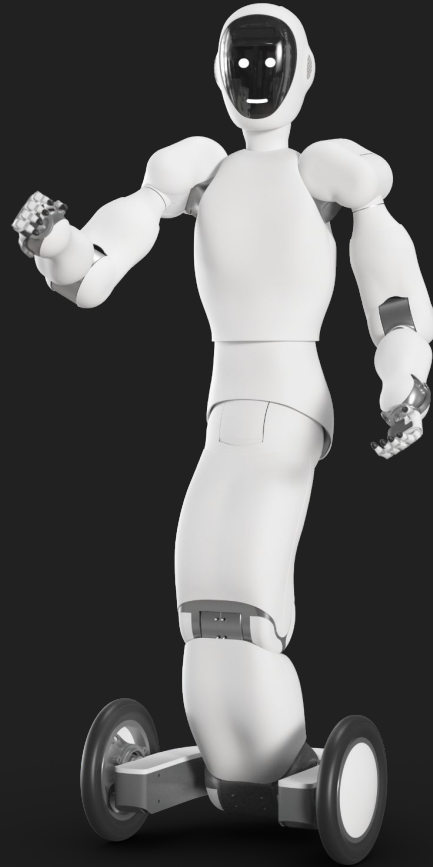


DATA

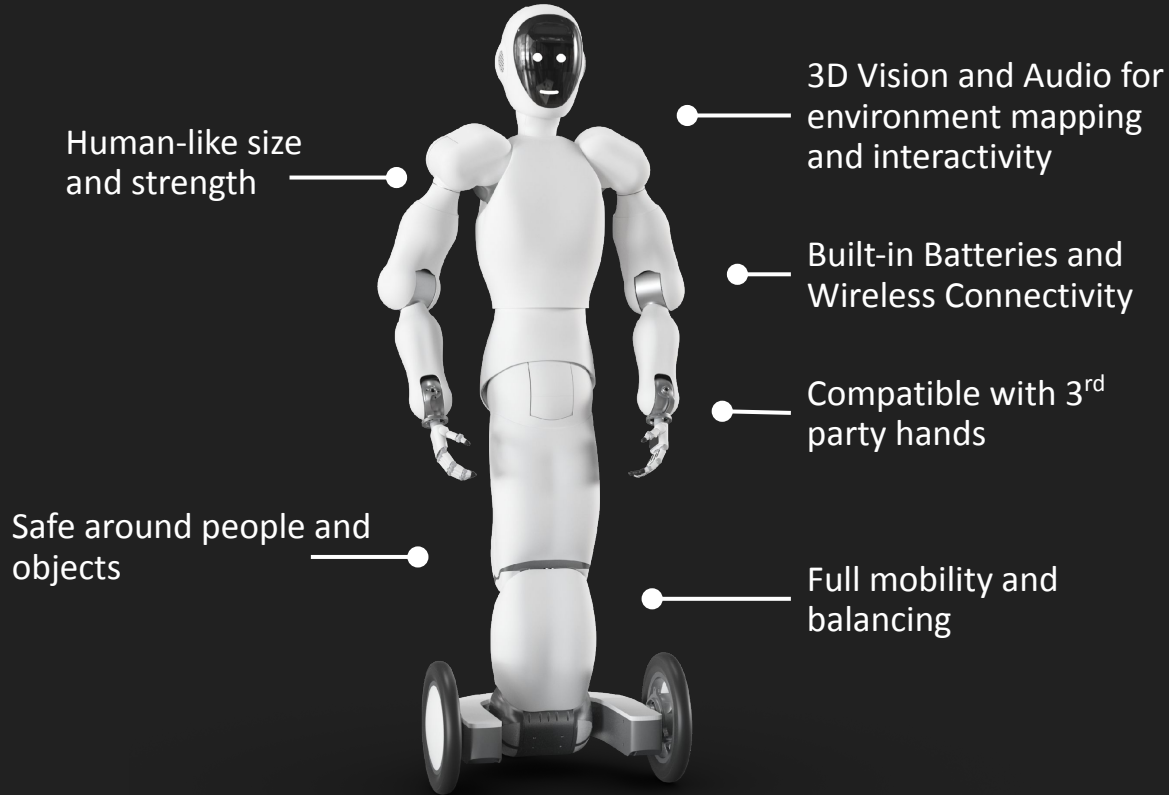


About Halodi Robotics

- Founded in 2015 in Norway to build safe, capable, and affordable robots to help human beings
- R&D robot shipping since Q1'2020
- Motor and drive technology patented and commercialized
- Offices in Norway, USA, Italy, and Canada
- 40+ employees from 10+ countries, many world leading roboticists



The eve robot



FEATURES

- Designed for unstructured human environments
- 23 degrees of freedom
- Native compliance
- Force and impedance control on all joints
- 8kg max reach payload per arm
- World leading dexterity, speed and strength





How can robots be
part of the human
world?







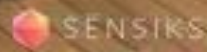


i-BOTICS



ETH zürich

TNO
Innovation
for life



UNIVERSITY
OF TWENTE



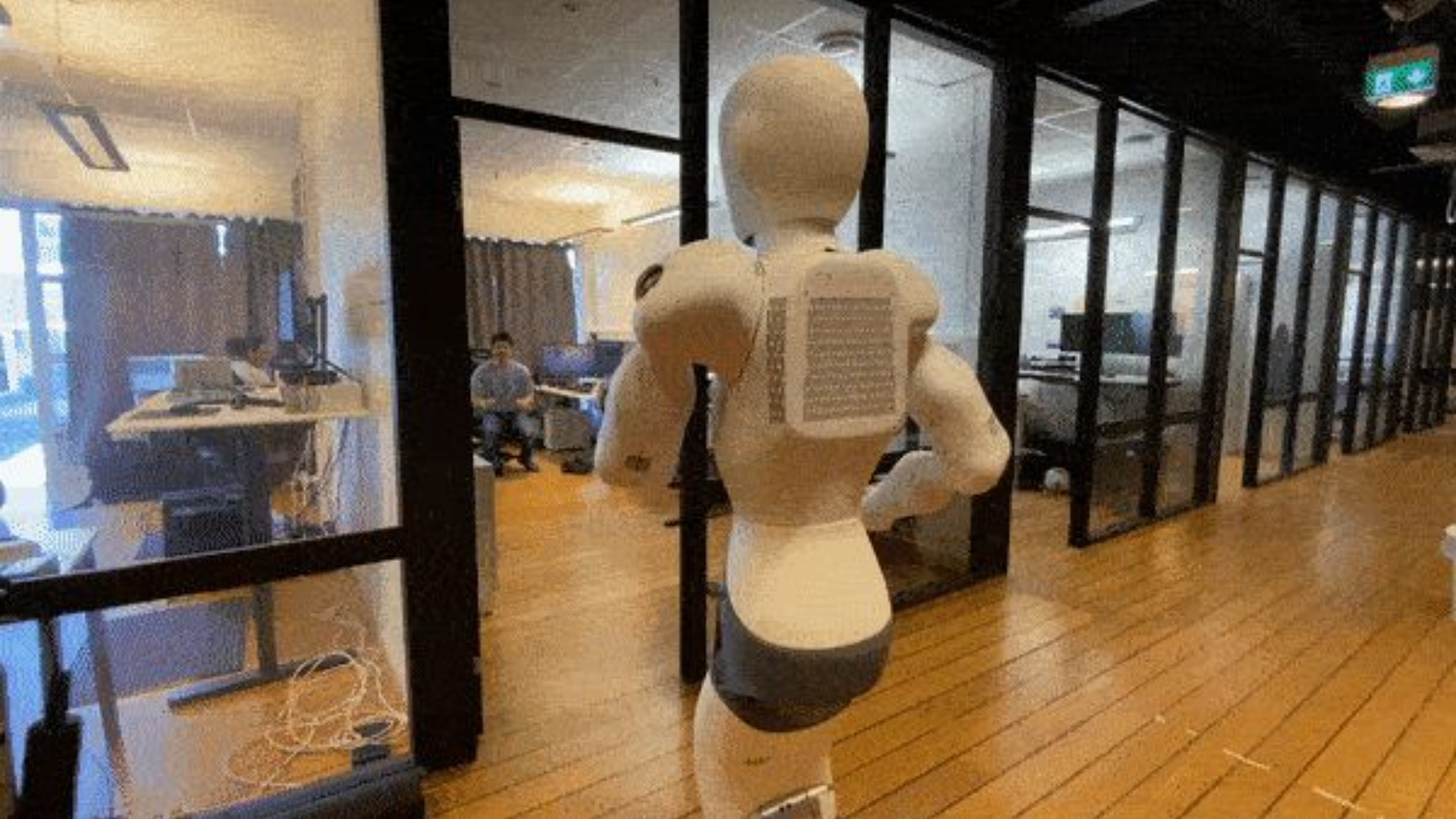
1x speed

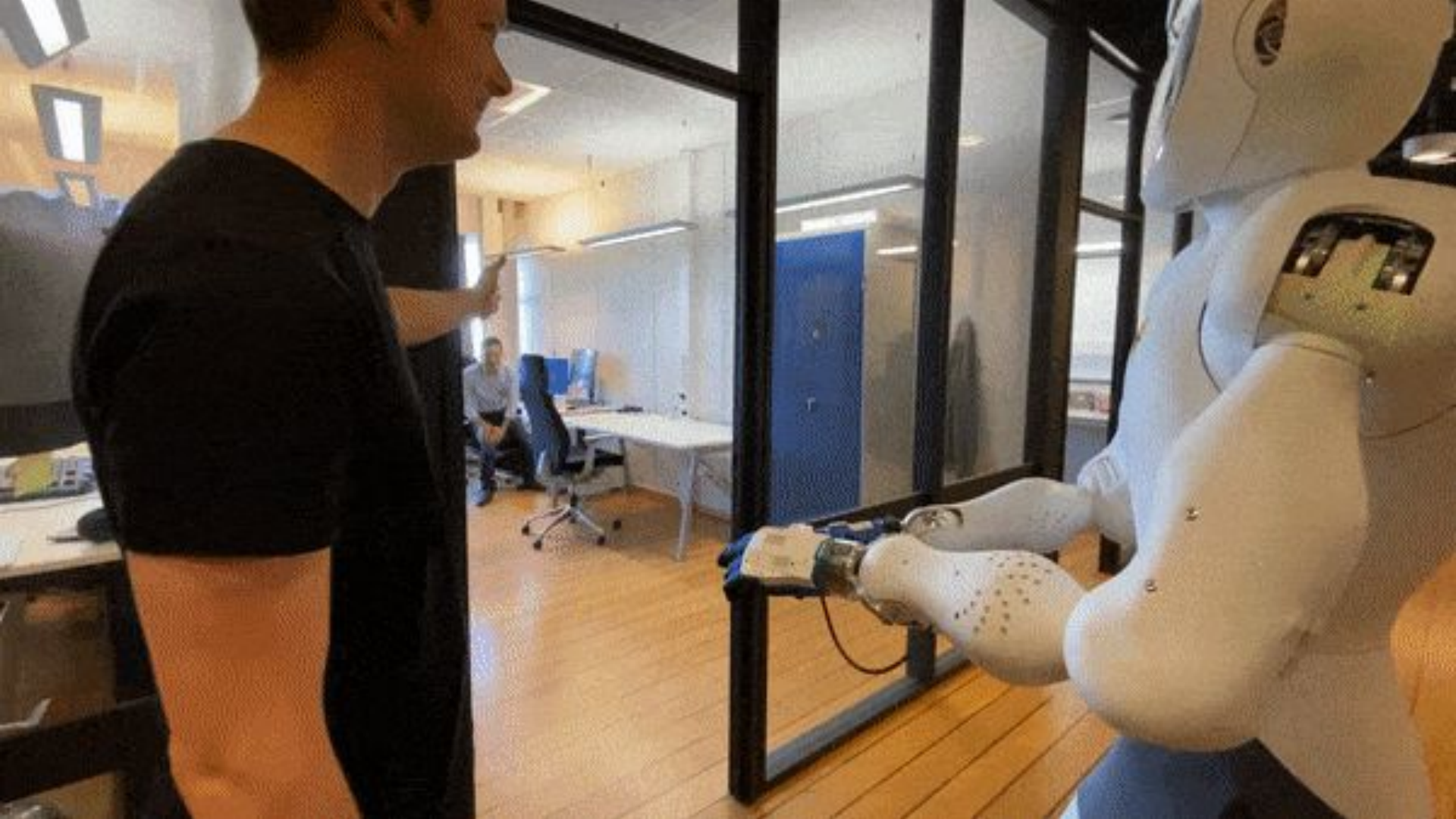


















Thank You!



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