

# Activity Recognition

CSE 599 N1: Modern Mobile Systems

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# What is Activity Recognition ?

- Detecting activities of daily living e.g. Eating, sleeping, Dishwashing, drinking water etc
- Useful for elderly people with dementia
- Keeping track of activities (e.g. count calories)
- Keep track of usage

# Common Steps

- Employ sensors to detect usage or action
- Define Activity
- Build a model to define activity
- Detect the activity

# Sensors

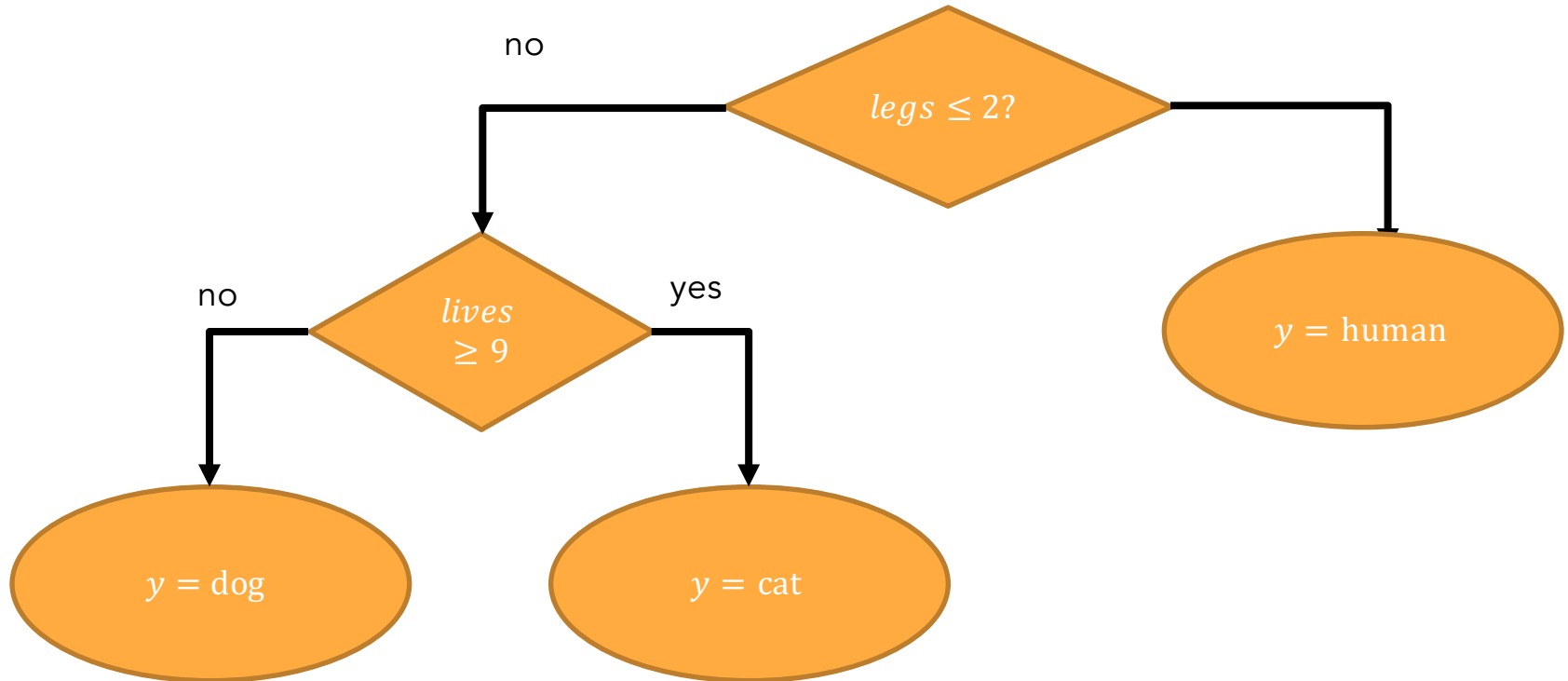
- RFID
- Camera
- Wired electrical sensors
- On body sensors like accelerometer
- Battery run motion sensors

# Define and build a model

- Define activity as a set of sub-activities
- Associate sensor readings to sub-activities
- Define timelines for sub-activities
- Construct a model or state machine

# Build decision trees

- Maps a combination of features to a class label based on a series of binary decisions

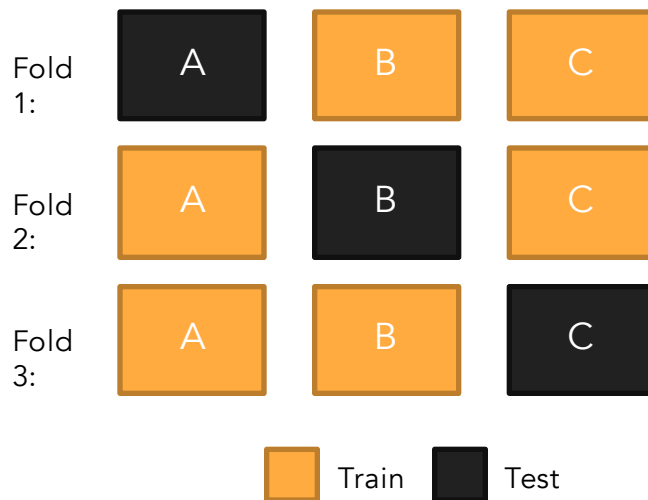


# Training: Cross-Validation

Repeated train-test splits so that you can test on all data

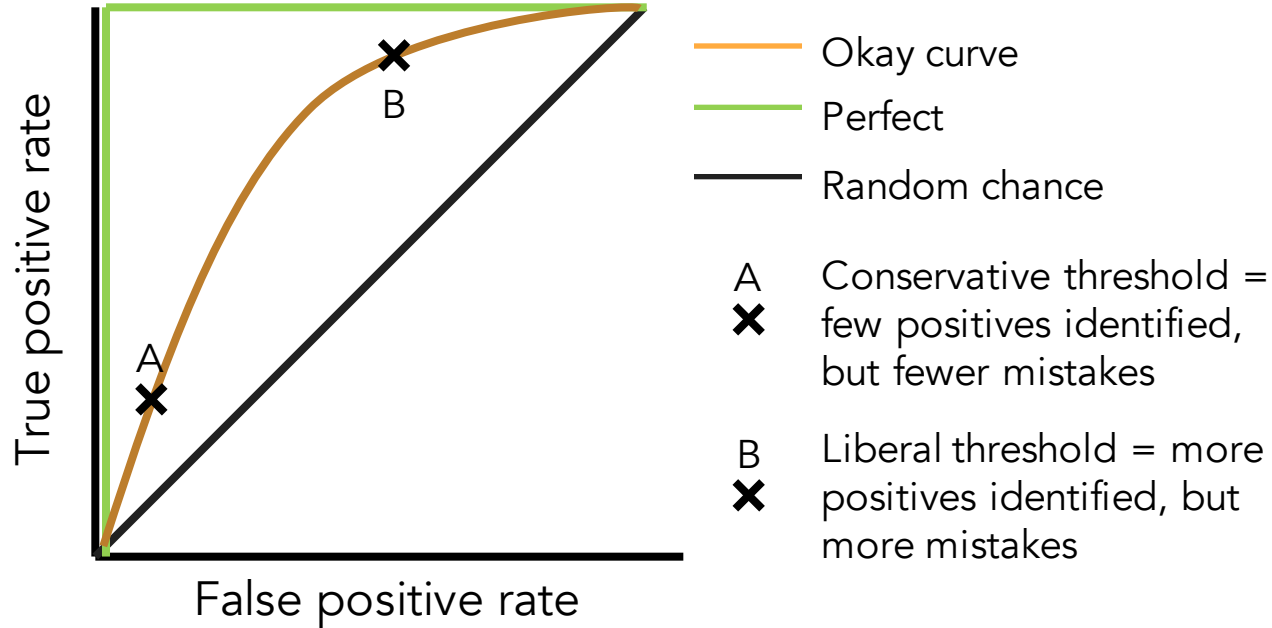
N-fold cross-validation: split dataset into N subsets

Leave-one-out cross-validation: special case of N-fold where  $N$ =number of users, samples, etc.



# ROC Curve

ROC = Receiver  
Operating Characteristic



Shows how a classifier's performance changes depending on different thresholds



# Inferring activities from interactions with objects

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# Sensor Setup

- Use RFID sensors
- Glove based RFID reader
- Identification Data sent to a computer



# Model – Think in terms of objects required

- Think activity in terms of recipe
- Activities are defined by objects used in a certain sequence
- Create a model with probabilities for each object
- Define timelines

# Model - Inference

- Construct a bayesian network
- Use sensor data and time elapsed as observed variables
- Activity is the hidden variable
- Use probabilistic estimation

# Evaluation

- 108 tags in a house
- 14 subjects each 45 minutes
- 14 actions
- Subjects selected 12/14

# Accuracy

- Activity detection – 88%
- Of detected activities, classification accuracy is 77%
- Metals and water bad for RFID
- Not enough data instances

# A long term evaluation of sensing modalities for activity recognition

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# Issues with current system

- Researchers performing activity
- Short recording sessions
- Using lab spaces
- Specific type of sensor
- Data labeled by researchers



# Sensor setup

- 101 reed switches
- 37 electrical flow sensors
- Infra red motion sensors
- 435 RFID with watch form factor reader
- 2 accelerometers
- Temperature, humidity, barometer etc

# classification

- Naive bayes or decision tree
- Leave one day out cross validation
- ROC curves to understand accuracy