LECTURE UNIT D
CORC 3303

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Sensors

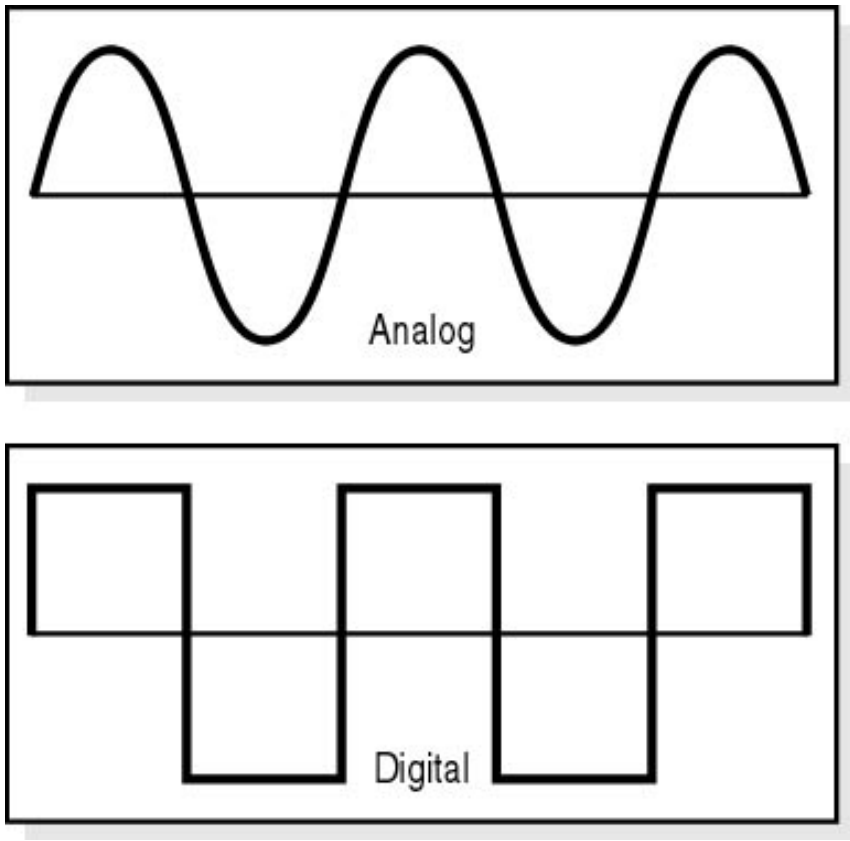
1. Key component/requirement of agents is the ability to perceive (percepts) their environment.
2. Sensors are the tools used by robots (and other agents) to determine both their internal and external states.
3. Sensors by themselves though, don't really tell a robot what is going on, the merely provide clues as to what might be happening.

Perceptual Systems

1. The perceptual system of a robot constitutes ALL of the sensors robot is using to try an help it determine its state.
2. Proprioceptive sensors (think proprietary) help monitor a robots internal state: position of wheels, arms battery power, etc.
3. Exteroceptive sensors help a robot determine the state of its surrounding world.
4. Uncertainty is always a problem in the real world as 'noise', errors and hidden or undiscovered variables can confuse a robot about its actual state.

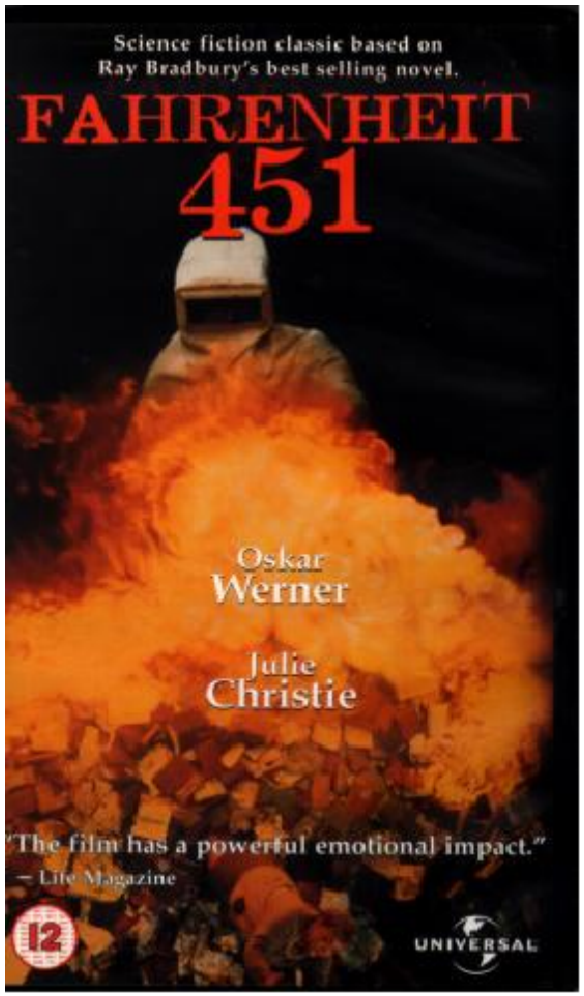
Discrete & Continuous

- Different sensors provide different levels (amounts) of information.
- That information comes in the form of discrete (digital) and continuous (analog) signals.
- More information in signal isn't necessarily better (is it enough to know that a switch has been flipped).
- More information in a signal may mean more processing will be required to make sense of that signal.



Signal to Symbol Problem

- The signal to symbol problem describes the following:
  - The output of a sensor, reliable, doesn't tell a robot what it should do.
  - Symbols are used to make information "abstract" and not "sensor-specific".
- Example:
  - Thermal sensor -> 451 degrees Fahrenheit
  - Implies that -> The library is on fire

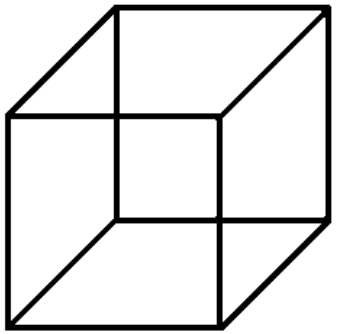


Sensor (Pre)Processing

1. Sensor Preprocessing refers to the need to process signal information into data the robot can actually use to make decisions.
2. This processing can happen at several levels:
    1. Electronics level: measuring the signal (on/off)
    2. Signal processing: (extracting, reducing, information from a signal) picking out one voice.
    3. Computation: Analyzing, comparing signal to identify/classify it.

Perception

- Perception is the process of understanding an environment by organizing and interpreting sensory information.
- Interpretations may vary.
- We can guide our perception in several different ways.
- The following methods are NOT mutually exclusive.



Action-Oriented Perception

- Actively searches environment for certain stimuli that would indicate a “goal” condition.
- Example: “Find a picture of a vase” = Look for column like shapes.
- May misinterpret information or miss important information that is not part of its search parameters.

Expectation Based

- Uses existing knowledge about the environment to help guide and constrain how input data is interpreted.
- Example: “Cubes are composed of 90 degree angles.” Therefore things that don't have 90 degree angles do not require further processing.
- Another example, motion detection alarm (if it's not moving, it can't be a thief).

Task Driven

- Direct sensors and perception utilities towards where more information is needed (or likely to be found).
- Humans do this all the time (turning head, moving eyes, filtering background noise).
- Harder for a robot to do.
- May miss important details.

Perceptual Classes

- Divide world up into categories that are useful for the task at hand.
- Classes in turn, might need further processing
  - Example Classes: (1) near, (2) far.
  - Example Classes: (1) Square, (2) round (3) other.

Big Picture

- Sensors provide information, NOT knowledge.
- Sensor data needs processing.
- Processing data into symbols, is an aspect of perception (red light means “stop”).
- Perception can be faulty (red light might mean “room is on fire”, hence stopping is bad idea).
- More sensor information isn't necessarily better, it just means more processing.
- Effective perception can be guided in several ways (action-oriented, expectation, task-driven, classes)

Passive & Active Sensors

- Passive sensors: Measure a physical property of the environment, and are composed of a detector.
  - Example: Bumper, Thermometer.

- Active Sensors: Consist of an emitter and a detector. Emitter produces a signal, the detector in turn measures the result of the output signal.
  - Example: Light Sensor, Laser Sensor, Sonar Sensor

Switches

- Simplest of all passive (discrete) sensor types. Can be used in a variety of ways.
- Contact Sensors: bumper.
- Limit Sensors: Trigger when object is at end or its range (mechanical arm).
- Shaft Encoders: Switch clicks each time a shaft rotates past a certain point.

Light Sensors

- Can be active, or passive sensor types.
- One of the simpler types of analog sensors.
- Ultimately only measures light intensity, which can then be used to detect things like distance and specific objects.
- Can also be used like a switch, when incorporated as a “break-beam” sensor.

Big Picture

- Sensors can be classified as active and passive, digital and analogue, simple and complex.
- Switches may be simple but can be setup to provide a wide variety of input information: contact, limits, shaft rotation.
- Light sensors come in a variety of forms, frequencies and uses.

The End