Lab 1 - AI, Agents, and Environments

# 1.1

* Intelligence = is the human ability to accumulate and apply knowledge to make decisions or perform skilled tasks
* Artificial Intelligence = is an effort to simulate the processes and outcomes of intelligent actors so as to mimic their decisions and skills
* Agent = is an autonomous entity capable of interacting with its environment with an intentionality towards a given goal or ideal state
* Rationality = is the property possessed by agents who are capable of making decisions in accordance with the knowledge and logic of the environment
* Logical Reasoning = is the ability to expand the knowledge of the environment by combining known features with logical relationships, or in other words, the ability to infer unknown information using known information

# 1.9

To what extent are the following computer systems instances of artificial intelligence:

* Supermarket bar code scanners
  + Simple reflex agent capable of receiving inputs and performing a preset associated action
* Web search engines
  + A model-based reflex agent that takes in inputs but combines them with NLP and the state of the web to determine the correct matches to the search, accounting for previous searches and the searches of others to inform those decisions
* Voice-activated telephone menus
  + A model-based reflex agent, similar to the web search in that it must use NLP and modeling to determine the meaning of the inputs, but at that point, it simply takes a predetermined action without consideration for any final goal or condition
* Internet routing algorithms that respond dynamically to the state of the network
  + Utility-based agent that is capable of examining a complex environment and making performance-based decisions to maximize the utility (throughput, speed) of the network

# 1.18

Examine the AI literature to discover whether the following tasks can currently be solved by computers:

* Playing a decent game of table tennis (Ping-Pong).
  + Yes – a robot exists that can not only play, but learn to strategize against their opponent.
* Driving in the center of Cairo, Egypt.
  + No – Driving rules are hectic and rarely followed, so this would be dangerous.
* Driving in Victorville, California.
  + Yes – See Tesla.
* Buying a week’s worth of groceries at the market.
  + No – Putting together a grocery list is one thing, but all that picking up items from shelves, if we could do that, Amazon wouldn’t still be employing humans.
* Buying a week’s worth of groceries on the Web.
  + Yes – See Amazon.
* Playing a decent game of bridge at a competitive level.
  + Yes – Bridge is too complex to be “solved” by AI, but a decent game, sure.
* Discovering and proving new mathematical theorems.
  + Yes – Apparently Google among others has done just that.
* Writing an intentionally funny story.
  + No, funny sure, intentional is where you lose me. This does border on a philosophical line though, they certainly can capitalize upon joke structure and popular culture trends to make jokes like a human comic, but is that intentional?
* Giving competent legal advice in a specialized area of law.
  + Yes – This also exists, a fair amount of law work is just crunching inputs and looking at historical data, very AI things to do.
* Translating spoken English into spoken Swedish in real time.
  + Yes – See Google Translate.
* Performing a complex surgical operation.
  + No – While AI can assist in surgery and even optimize surgical approaches and processes, too much can go wrong in real time for this to be a good idea yet.

# 2.4

For each of the following assertions, say whether it is true or false and support your answer with examples or counterexamples where appropriate.

1. An agent that senses only partial information about the state cannot be perfectly rational.
   1. False, rationality depends on making the correct decision given the information you have. If the agent has partial information, it just has to make the correct decision with that version of state to be rational.
2. There exist task environments in which no pure reflex agent can behave rationally.
   1. True, a pure reflex agent just responds to the current percept, so can make irrational decisions if you need a knowledge of history.
3. There exists a task environment in which every agent is rational.
   1. True, if the environment is incredibly limited, then every agent would make the same valid choice.
4. The input to an agent program is the same as the input to the agent function.
   1. False, the program is the implementation not the mathematical concept, so there may need to be some steps to process real world signal data or marshal it in some fashion.
5. Every agent function is implementable by some program/machine combination.
   1. False, things can get far too complicated. If this were true, then you could theoretically program God, so unless by any machine we mean one that possesses infinite memory and processing power, there just are limits.
6. Suppose an agent selects its action uniformly at random from the set of possible actions. There exists a deterministic task environment in which this agent is rational.
   1. True, if things are simple enough and the random choices always work out, then the agent would be behaving rationally, albeit just by luck.
7. It is possible for a given agent to be perfectly rational in two distinct task environments.
   1. True, many situations have similar structures and parallels, so one rule set could work in multiple instances. For example, an abstract enough poker AI could make rational choices even if some aspect of gameplay changed slightly.
8. Every agent is rational in an unobservable environment.
   1. False, rationality depends on making the valid choice given inputs, so if there are no inputs, there are no choices and no rationality.
9. A perfectly rational poker-playing agent never loses.
   1. False, poker is still a game of chance. Betting on a full house is a valid choice, but if your opponent happens to have a flush, you would still lose.

# 2.5

For each of the following activities, give a PEAS description of the task environment and characterize it in terms of the properties listed in Section **env-properties-subsection**.

* Performing a gymnastics floor routine.
  + P – Score from judges
  + E – gymnastics floor
  + A – legs, arms, hips, etc.
  + S – eyes, legs, arms, etc.
  + Environment – observable, stochastic, sequential, dynamic, continuous, single agent, unknown
* Exploring the subsurface oceans of Titan.
  + P – are explored, time explored, accidents avoided
  + E – subsurface oceans of Titan
  + A – Steering, accelerator, brakes, diving tech, etc.
  + S – video, mics, infrared, pressure sensors
  + Environment – partially observable, stochastic, sequential, dynamic, continuous, single agent, unknown
* Playing soccer.
  + P – score points, win game
  + E – soccer field
  + A – legs, feet, arms, head, etc.
  + S – eyes, ears, legs, etc.
  + Environment – partially observable, stochastic, sequential, dynamic, continuous, multi-agent, unknown
* Shopping for used AI books on the Internet.
  + P – money saved
  + E – online book marketplaces
  + A – DOM interface
  + S – Web APIs
  + Environment – partially observable, stochastic, sequential, dynamic, continuous, multi-agent, unknown
* Practicing tennis against a wall.
  + P – balls hit
  + E – ground and wall
  + A – tennis racket
  + S – Eyes, ears, arm, etc.
  + Environment - observable, stochastic, sequential, dynamic, continuous, single-agent, unknown
* Performing a high jump.
  + P – height of jump
  + E – track, jump bar
  + A – Legs, feet, etc.
  + S – Eyes, ears, etc.
  + Environment - observable, stochastic, sequential, dynamic, continuous, single-agent, unknown
* Bidding on an item at an auction.
  + P – item won, amount paid
  + E – auction house
  + A – Little sign with a number on it
  + S – Ears, eyes, etc.
  + Environment - partially observable, stochastic, episodic, dynamic, continuous, multi-agent, unknown

# 2.6

Define in your own words the following terms:

* Agent
  + An entity capable of perceiving and interacting rationally within an environment
* agent function
  + A theoretical mapping of percept sequences to actions
* agent program
  + The implementation of an agent function that determines actions given percept sequences
* Rationality
  + Making the correct, or valid decision, given a certain set of inputs. If A is true, and A then B is true, then provided A, B is a valid choice.
* Autonomy
  + The trait of being responsible for one’s actions
* reflex agent
  + An agent that simply responds to percepts with a rule set
* model-based agent
  + An agent that takes precepts and considers how its own actions affect the environment to determine its action
* goal-based agent
  + An agent that in addition to a model of how its behavior affects the environment, also has a means of determining benefit and will choose the action it sees as most beneficial.
* utility-based agent
  + An agent that uses goals and models, but also can parse relative value of various actions and will seek to optimize its own actions to maximize benefit.
* learning agent
  + An agent capable of operating with utility-based judgment in initially unknown environments that require information gathering and adaptation.

# Part 3

1. The blind dog is an agent because it responds to precepts with actions, similar to our robot vacuum cleaner example.
   1. P – food/water consumed, food and water get graphic identifiers later on
   2. E – the park class, moves from 1 dimensional to 2 dimensions with graphics
   3. A – execute\_action() – move or eat/drink
   4. S – percept() – is there food or water here
2. The energetic dog agent does change the environment, because it changes the ability to interact within it. By being able to turn and explore the 2 dimensional space, the environment and actuators shift.
3. 1. From the agent point of view, it would be partially observable as the dogs can’t check cells contents without being there.
   2. This is definitely deterministic, you either move or eat and the outcomes are defined.
   3. I would argue this is episodic. The dog moves, percepts and makes a decision. You could argue that since the environment is changed and a dog could return to that space and therefore not be able to eat, that the decision affected a later one, but effectively, the choice to move or eat is independent from all others.
   4. This is static, nothing happens while the dog deliberates.
   5. Certainly discrete, there are in face a rather limited number of possibilities for a such an example.
   6. There is but one dog, so single agent.
   7. Known, there are few implications of its decisions, but the dog definitely isn’t learning to interact with the environment.
4. Yes, by making the park two dimensional, you change the ways in which an agent may interact, expanding both the potential for percepts and actions.