3806ICT - Week 3 Lab

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Question 1

Give definitions of locomotion and manipulation. What are their shared features and differences?

Locomotion is defined as a robot's ability to move itself by exerting force on the environment whereas manipulation is its ability to move objects by exerting force upon them.

Question 2

What are advantages and disadvantages of legged robots?

Easiest format to see this in would be lists:

Advantages

- They can go over more complicated obstacles without getting stuck (slanted ground, steps, et cetera)
- Causes less damage to terrain than wheeled robots

Disadvantages

- Movement speed
- Complexity - actuators and structure are a lot more complicated
- Harder to control - must consider balance and stability
- Less energy efficient due to:
  - Terrain
  - Centre of gravity moves while walking
  - Picking up the legs

Question 3

What is DOF? If a robot can only move forward and backward, how many DOFs does it have? In most cases, how many DOFs does a robot leg has?

DOF stands for **d**egrees **o**f **f**reedom, and its defined by the number of joins in each leg. To have a leg that only moves forwards and backwards, it would have two joints: this is because its limited to doing a lift and swing motion. To move backwards it just swings in the other direction than normal. Most robot legs have three joints.

Question 4

What is a gait of a legged robot? Enumerate all lift and release events of a robot with 4 legs. Give two examples of gaits for such a robot.

Our formula to find how many states there are is $2^k = 2^4 = 16$ states.

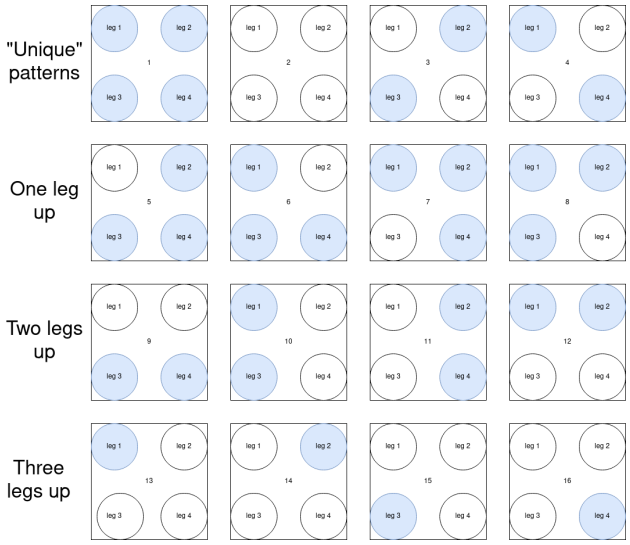

Figure 1: Blue means a leg is down and white is the leg is up

Now to depict gaits, we can consider the way that a horse moves since it has a walk, trot, canter and gallop. Let's do the walk and gallop.

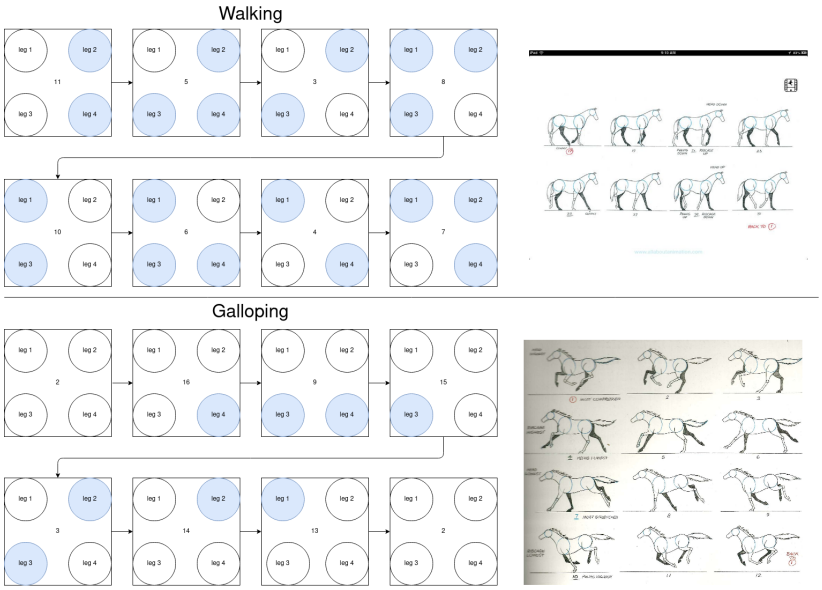

Figure 2: The sources used are from http://allaboutanimation.com/ and http://theanimatorssurvivalkit.com/

Question 5

Formulate the Monkey and Banana Problem in STRIPS:A monkey is at location A in a lab. There is a box in location C. The monkey wants the bananas that are hanging from the ceiling in location B, but it needs to move the box and climb onto it in order to reach them

There's a couple of things to clarify here before we start. First of all, like the example in the slides the hand is not an object in the domain, meaning the monkey shouldn't be either.

Secondly, the goal state is slightly ambigious. By the wording of the problem it could mean that the monkey only wants to be able to reach them, but for this lets define the operation of grabbing bananas as well (therefore the goal is just having the bananas). This also brings another issue to light, should the goal state include the location and that the monkey is standing on the box? Lets define this as the monkey has bananas, the box is at B and is holding the bananas.

Another question is whether the bananas are counted as an object. Technically the monkey doesn't actually interact with them (i.e. picking them up) as it simply gains the state of having the bananas. For our case lets say the bananas are an object and the goal is carrying(bananas)

Domain Model

Objects

- A, B, C, box, bananas

Predicates

- Location(?X) : X is a location
- Box(?X) : X is a box
- Bananas(?X): X is bananas
- Hanging(?X) : X is hanging from the ceiling
- At(?X, ?Y) : X is at location Y
- ClearFloor(?X) : Location X has nothing on its floor
- ClearCeiling(?X) : Location X has nothing on its ceiling
- Carrying(?X) : Monkey is carrying X
- HandsFree() : Monkey isn't carrying anything
- MonkeyLocation(?X) : Monkey is at X; can be a location or a box (given the monkey is on the box).
- MonkeyNOTOnBox(?X) : Monkey isn't standing on the box

States

- Initial State Location(A), Location(B), Location(C), Box(box), Bananas(bananas), Hanging(bananas), At(box, C), At(bananas, B), HandsFree(), MonkeyLocation(A)
- Goal state MonkeyLocation(box), At(box, B), Carrying(bananas)

World Operators

- PickUpBox(?X, ?Y)
  - Pre: Box(?X), Location(?Y) HandsFree(), MonkeyNOTOnBox(?X), MonkeyLocation(?Y), At(X, Y)
  - Effects+: Carrying(?X), ClearFloor(?X)
  - Effects-: FreeHands(), At(?X, ?Y)
- PutDownBox(?X, ?Y)
  - Pre: Box(?X), Location(?Y), Carrying(?X), MonkeyLocation(?Y), ClearFloor(?X)
  - Effects+: FreeHands(), At(?X, ?Y)
  - Effects-: Carrying(?X), ClearFloor(?Y)
- MoveToLocation(?X, ?Y)
  - Pre: Location(?X), Location(?Y), MonkeyLocation(?X)
  - Effects+: MonkeyLocation(?Y)
  - Effects-: MonkeyLocation(?X)
- ClimbOnBox(?X, ?Y)
  - Pre: Box(?X), Location(?Y), MonkeyLocation(?Y), At(?X, ?Y)
  - Effects+: MonkeyLocation(?X)
  - Effects-: MonekyLocation(?Y)
- PickUpBanana(?X, ?Y, ?Z)
  - Pre: Banana(?X), Hanging(?X), Box(?Y), Location(?Z), MonkeyLocation(?Y), At(?Y, ?Z), FreeHands()
  - Effects+: Holding(?X), ClearCeiling(?Z)
  - Effects-: FreeHands(), At(?X, ?Z), Hanging(?X)

Question 6

Evaluate the subsumption architecture in terms of: support for modularity, niche targetability, ease of portability to other domains, robustness

Question 7

Describe the Hybrid paradigm in terms of: (a) sensing, acting, and planning, and (b) sensing organization.

Question 8

Look up technical reports on Shakey. Compare Shakey with the Hybrid architectures. Now consider the possible impact of the radical increases in processing power since the 1960's. Do you agree or disagree with the statement that Shakey would be as capable as any Hybrid if it were built today? Justify your answer.