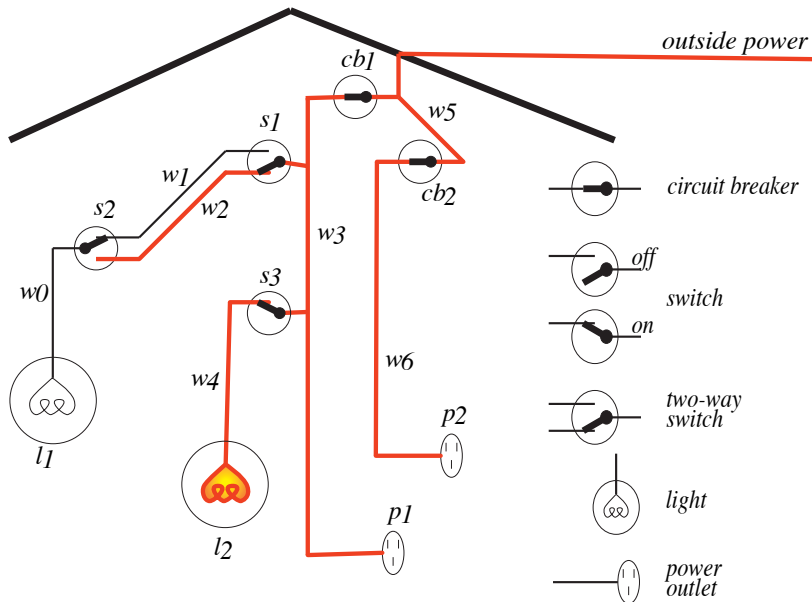


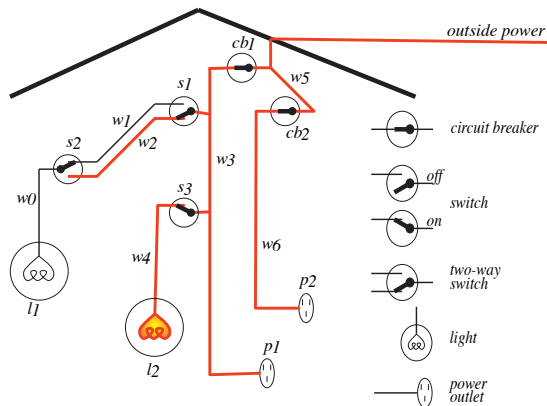
# Electrical Domain



- In the electrical domain, what should the house builder know?
- What should an occupant know?
- Users can't be expected to volunteer knowledge:
  - ▶ They don't know what information is needed.
  - ▶ They don't know what vocabulary to use.

- Users can provide observations to the system.
- They typically don't know what information is useful, and don't know the syntax or terminology to use.
- They can answer questions.
- **Askable** atoms are those that a user should be able to provide a truth value for.
- There are 3 sorts of atoms to be proved in the top-down proof procedure:
  - ▶ how for which the user isn't expected to know the answer
  - ▶ askable atoms that may be useful in the proof
  - ▶ askable atoms that the user has already provided information about.
- The top-down proof procedure can be modified to ask users about askable atoms they have not already provided answers for.

# Electrical Environment (aipython.org interaction)



```
python -i logicExplain.py
interact(elect)
ask lit_l1
```

# Knowledge-Level Explanation

- **HOW** questions can be used to ask how an atom was proved. It gives the rule used to prove the atom. A user can ask HOW an element of the body of that rules was proved. This lets the user explore a proof. (Continuing the aipython session):

```
ask lit_l1
how
how 1
```
- **WHY** questions can be used to ask why a question was asked. It provides the rule with the asked atom in the body. You can ask WHY the rule in the head was asked.

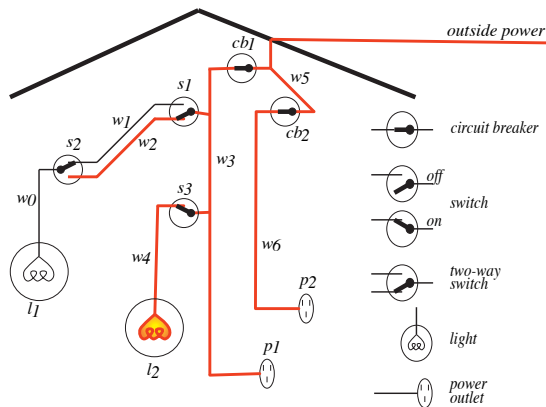
There are four types of non-syntactic errors that can arise in rule-based systems:

- An incorrect answer is produced: an atom that is false in the intended interpretation was derived.
- Some answer wasn't produced: the proof failed when it should have succeeded. Some particular true atom wasn't derived.
- The program gets into an infinite loop.
- The system asks irrelevant questions.

# Debugging incorrect answers (false positives)

- Suppose atom  $g$  was proved but is false in the intended interpretation.
- There must be a rule  $g \leftarrow a_1 \wedge \dots \wedge a_k$  in the knowledge base that was used to prove  $g$ .
- Either:
  - ▶ one of the  $a_i$  is false in the intended interpretation or
  - ▶ all of the  $a_i$  are true in the intended interpretation.
- Incorrect answers can be debugged by only answering yes/no questions.

# Electrical Environment (aipython.org interaction)



```
python -i logicExplain.py
interact(elect_bug)
ask lit_l1
how
how 1
```



## Missing Answers (false negatives)

If atom  $g$  is true in the intended interpretation, but could not be proved, either:

- There is no appropriate rule for  $g$ .
- There is a rule  $g \leftarrow a_1 \wedge \dots \wedge a_k$  that should have succeeded.
  - ▶ One of the  $a_i$  is true in the interpretation and could not be proved.