CPSC 322

Introduction to Artificial Intelligence

November 29, 2004

Things...

There will be a practice homework assignment coming.

Using plans in language understanding

Knowledge of goals and plans is useful in block-stacking and route-finding, but it’s also essential in understanding stories that describe unusual events.

That means we use goals and plans all the time when reading or listening, because it’s usually the unusual events that motivate telling the story in the first place.

Using plans in language understanding

For example, this story isn't all that unusual. It's also the kind of story that people don't really tell. Why would they? It happens all the time...it's not worth telling.

John and Mary went to McDonald's.
John ordered a Big Mac and fries.
Mary had a Quarter Pounder.
John put the trash in the wastebasket.
They went home.

Using plans in language understanding

On the other hand, this is the kind of story that people would find to be much more interesting and therefore worth telling:

John and Mary went to McDonald’s.
John ordered a Big Mac and fries.
Suddenly, Mary’s husband Lenny burst through the door with a shotgun.
John hid under a table.

Using plans in language understanding

Is Lenny going duck hunting?
Is he going to ask if anyone lost a shotgun outside?
Will he try to trade the shotgun for some McNuggets?

John and Mary went to McDonald's.
John ordered a Big Mac and fries.
Suddenly, Mary's husband Lenny burst through the door with a shotgun.
John hid under a table.

How do you know?

Using plans in language understanding

What are the goals that drive John, Mary, and Lenny?
What plans are they executing to fulfill those goals?

John and Mary went to McDonald’s.
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Suddenly, Mary’s husband Lenny burst through the door with a shotgun.
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How do you know?

Using plans in language understanding

Here is a simpler example (maybe):

John needed money for a down payment on a new house.
He got his gun and went to the 7-Eleven store on the corner.

As with any story, understanding involves making the inferences that connect one sentence to another.

In this case, we're given John's goals in the first sentence, and we have John's actions in the next sentence. We assume that the two sentences are related because they come one after the other. How can we do this?

Using plans in language understanding

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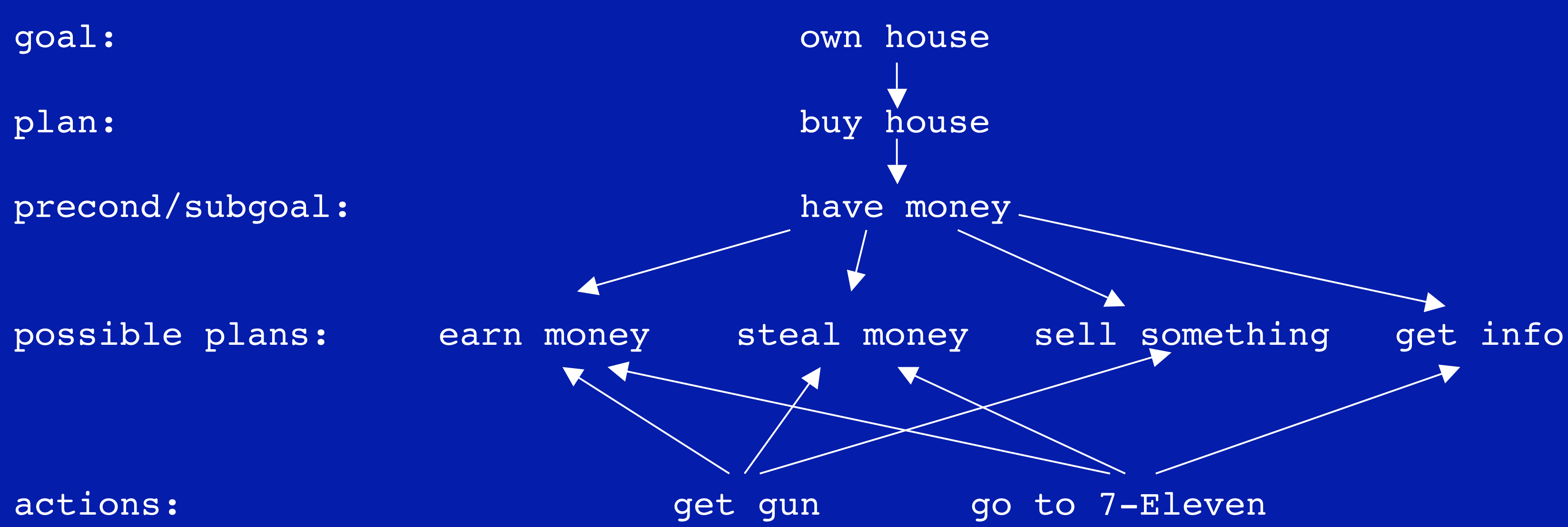

How do you figure out which plan is the connection?

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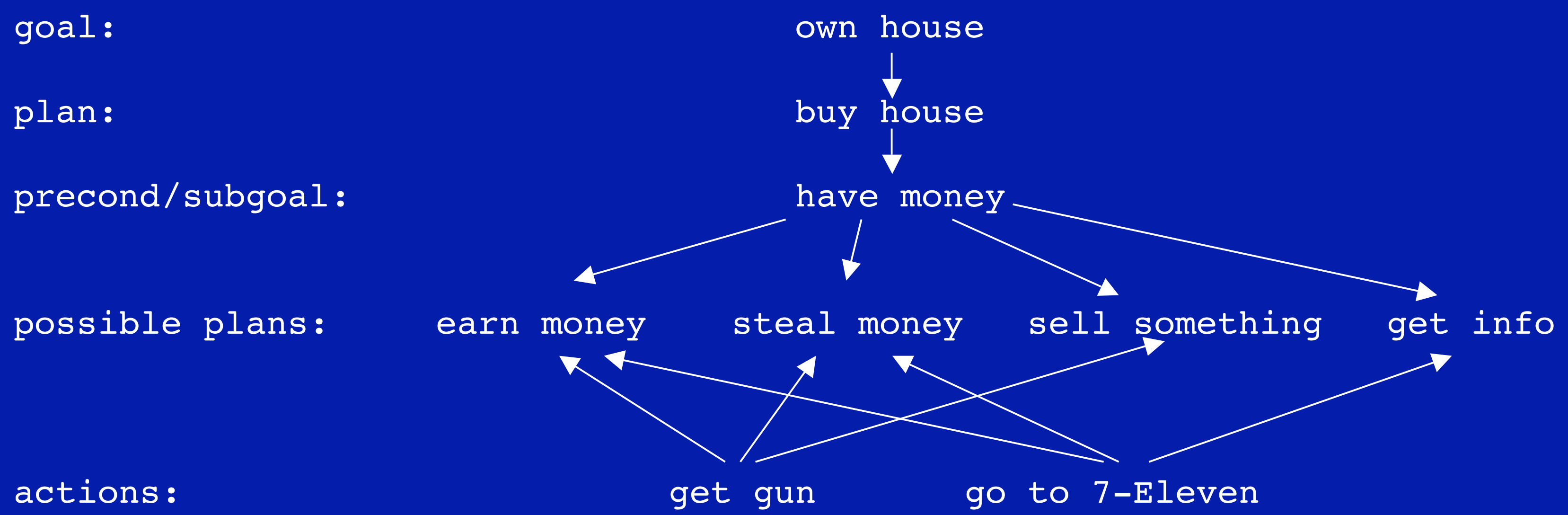

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The get info plan doesn’t easily explain the gun.

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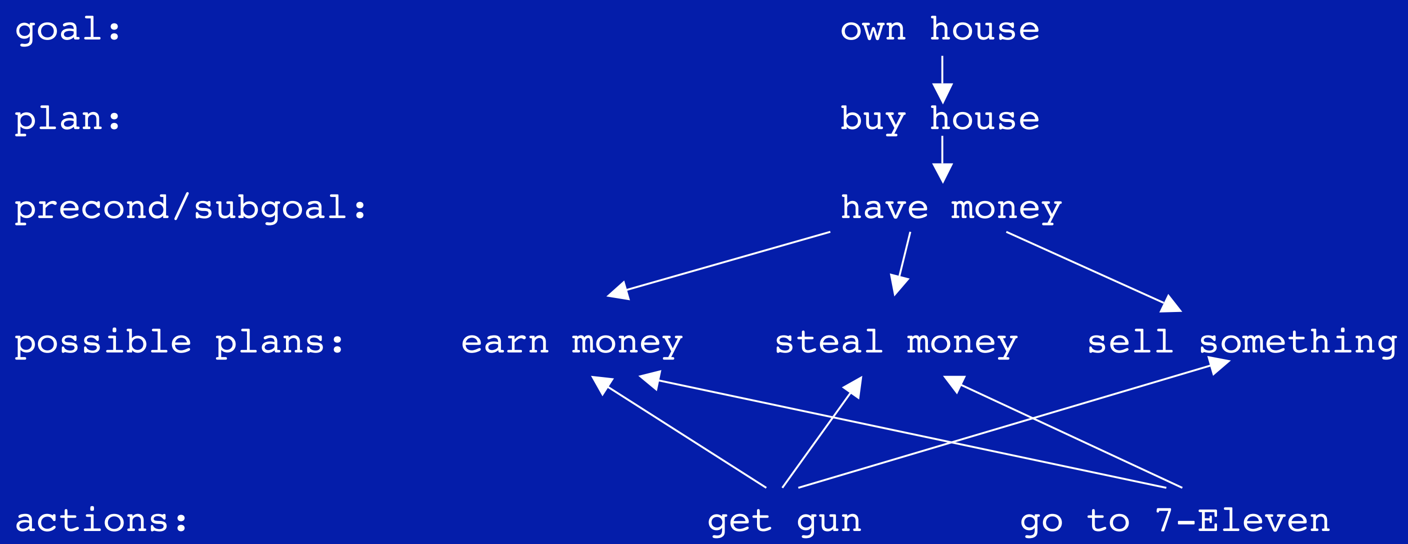

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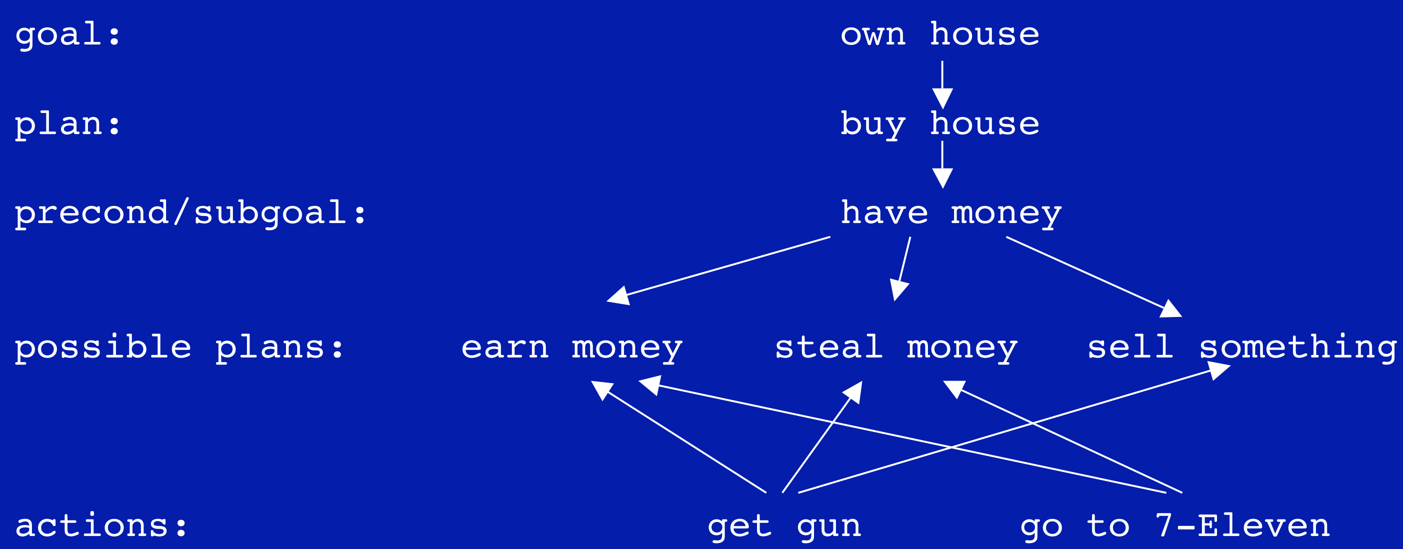

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The sell something plan may not explain the 7-Eleven.

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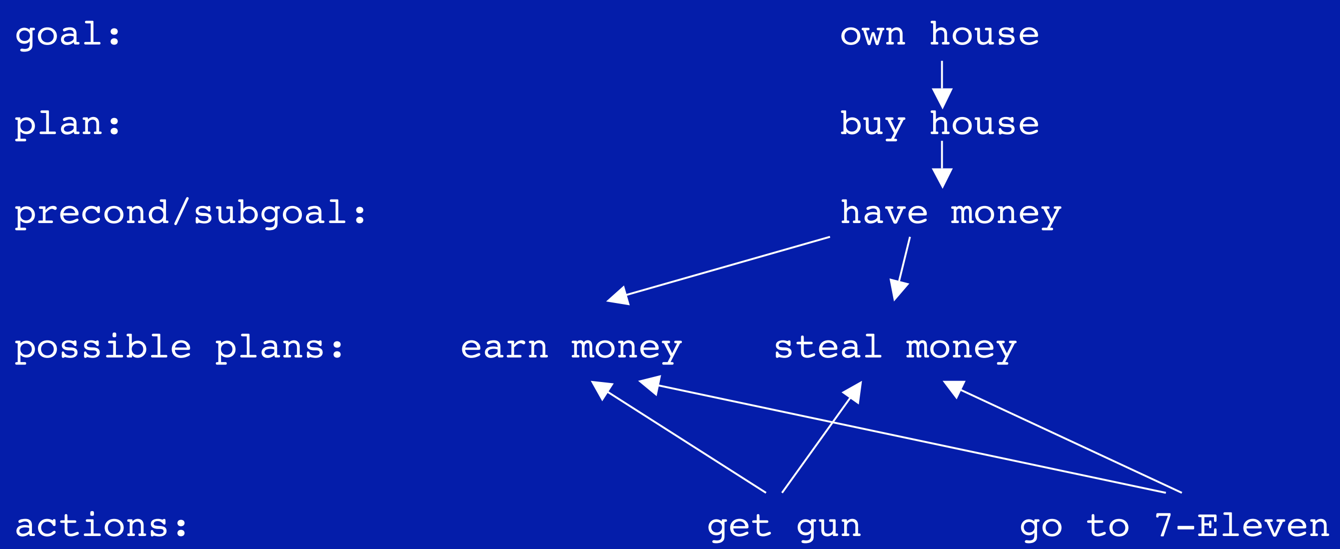

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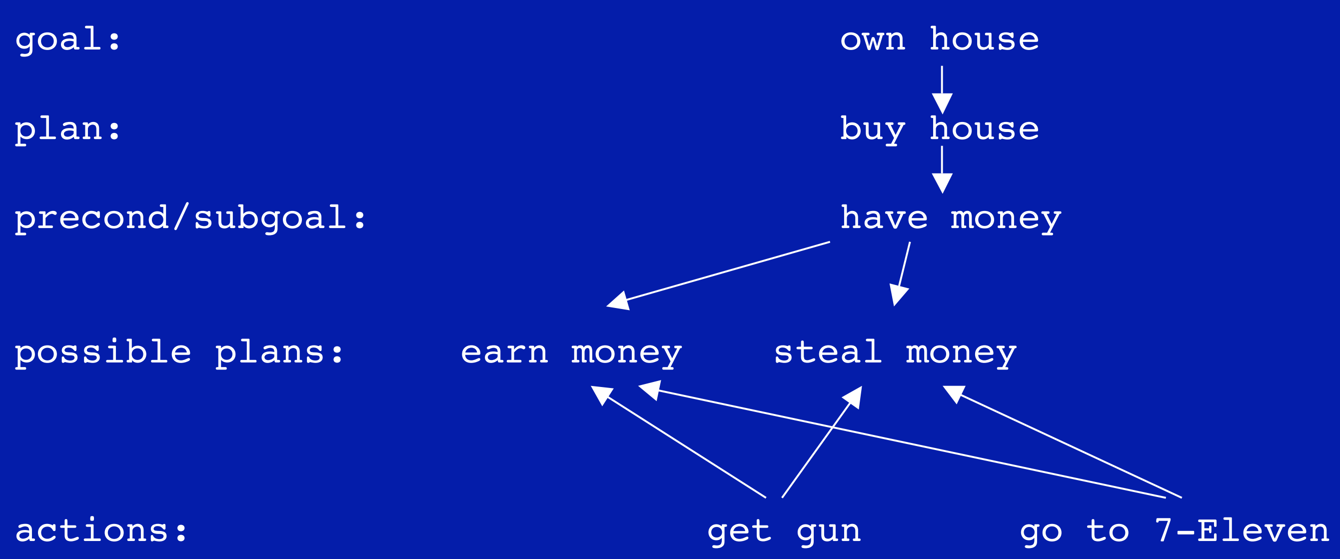

How do you figure out which plan is the connection?
We've learned to think that guns are tools for overpowering people (precondition to stealing), not for earning a living.

Using plans in language understanding

John needed money for a down payment on a new house.
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```
goal:                 own house
plan:                 buy house
precond/subgoal:      have money
possible plans:       steal money
actions:              get gun        go to 7-Eleven
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                                  ↓
precond/subgoal:               have money
                                  ↓
possible plans:              steal money
                              ↑         ↑
actions:                get gun      go to 7-Eleven
```

That plan of stealing money becomes the context for understanding these two sentences as well as those that follow.

Using plans in language understanding

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goal:                 own house
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actions:              get gun        go to 7-Eleven
```

Where does that knowledge about an actor's goals and plans come from? Are we born with it? No, it comes from...

Learning (chapter 11)

Learning is the “holy grail” of artificial intelligence because it is the essential element in intelligence -- both natural and artificial. Why?

Learning

Learning is the “holy grail” of artificial intelligence because it is the essential element in intelligence -- both natural and artificial. Why?

People change as a result of their experiences. We adapt to new situations and learn from our experiences. If machines are going to be intelligent, they must be able to do the same.

Learning

Learning is the “holy grail” of artificial intelligence because it is the essential element in intelligence -- both natural and artificial. Why?

It’s probably impossible to build in the large amount of knowledge required for any realistic domain by hand.

Learning

Learning is the “holy grail” of artificial intelligence because it is the essential element in intelligence -- both natural and artificial. Why?

Dealing with novel input inherently requires adaptation and learning (otherwise the system will only be able to deal with situations for which it was designed).

Learning

Learning is the “holy grail” of artificial intelligence because it is the essential element in intelligence -- both natural and artificial. Why?

Dealing with changing environments requires learning (since the knowledge base may otherwise become obsolete).

Learning

Learning is the “holy grail” of artificial intelligence because it is the essential element in intelligence -- both natural and artificial. Why?

It’s the only way that artificially intelligent systems will seem really intelligent to people.

Learning

Definition: learning is the adaptive changes that occur in a system which enable that system to perform the same task or similar tasks more efficiently or more effectively over time.

This could mean:

- The range of behaviors is expanded: the agent can do more
- The accuracy on tasks is improved: the agent can do things better
- The speed is improved: the agent can do things faster

What kinds of learning do we do?

Here are some examples of the kinds of learning that people do. This is not an exhaustive list...

What kinds of learning do we do?

Rote learning

“1 times 3 is 3, 2 times 3 is 6, 3 times 3 is 9,...”

Taking advice from others

“If you have one piece close to the other end of the Oska board, try sacrificing some of your other pieces”

Learning from problem solving experiences

“I have to stack these blocks again...what do I know from last time that’ll make this time easier so I don’t have to do the planning thing again?”

Learning from examples

“Hmmm, last time at the watering hole, Og was eaten. The time before that, Zorg was eaten. I’m getting kind of thirsty....”

Learning by experimentation and discovery

“I wonder what will happen if I move this piece to that space?”

What kinds of learning do AI folks study?

supervised learning: given a set of pre-classified examples, learn to classify a new instance into its appropriate class

unsupervised learning: learning classifications when the examples are not already classified

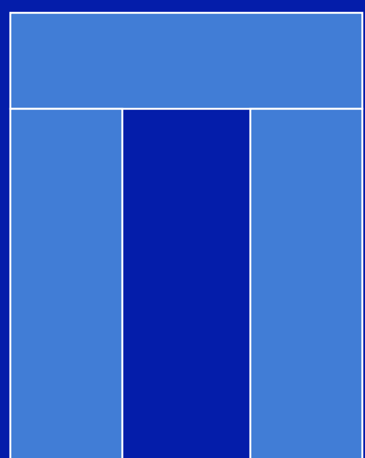
reinforcement learning: learning what to do based on rewards and punishments

analytic learning: learning to reason faster

(again, this is not an exhaustive list)

Example: Supervised learning of concept

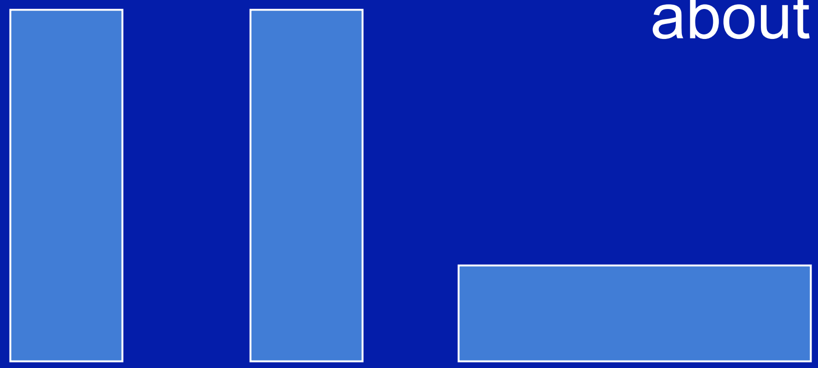
Say it's important for your system to know what an arch is, in a structural sense. You want to teach the program by a series of examples. You tell your system that this is an arch:



What does your system know about "archness" now?

Example: Supervised learning of concept

Now you tell it that this isn't an arch:



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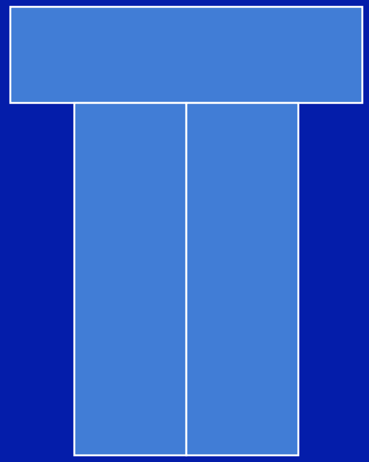

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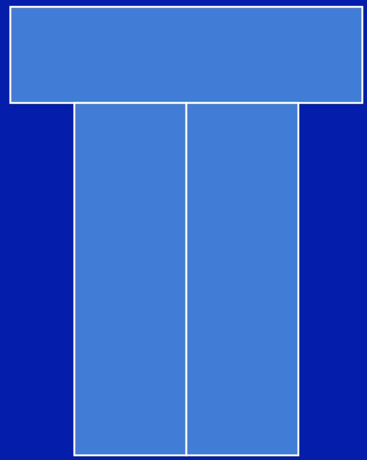
Example: Supervised learning of concept

This may not seem all that exciting, but consider the same sort of task in a different domain....



What does your system know about “archness” now?

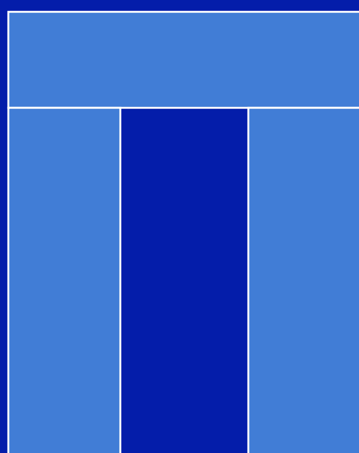
Example: Supervised learning of concept

What does your system know about "winning horses" now?

But I digress....

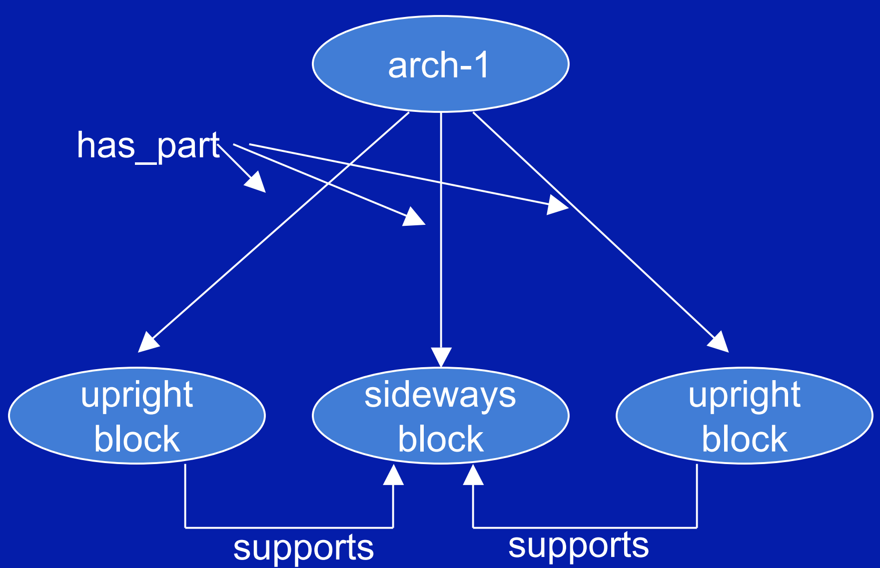
Example: Supervised learning of concept

Let’s go back to the simpler arch problem and see how a computer program could learn the concept



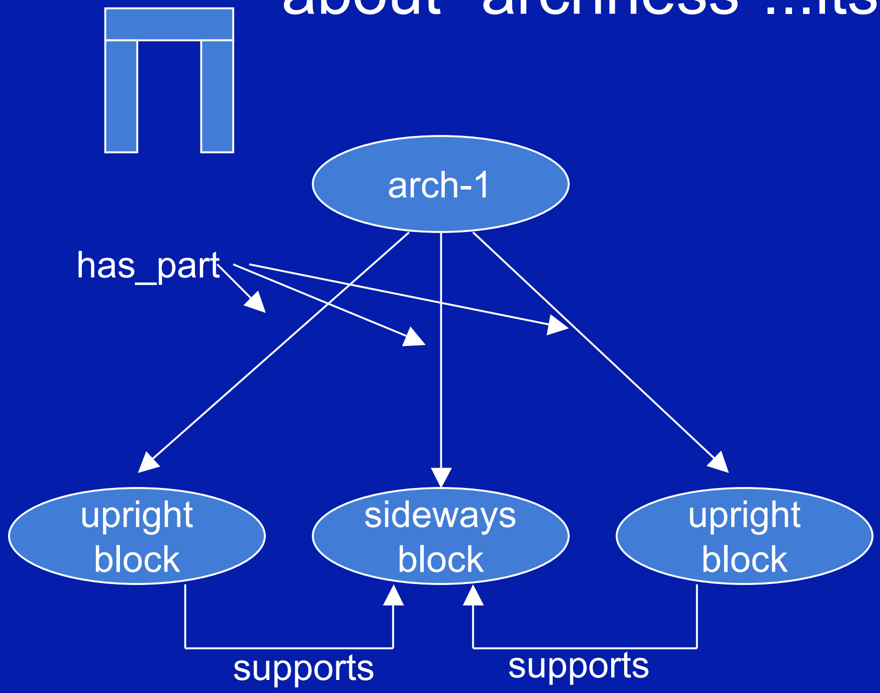
Example: Supervised learning of concept

We need to provide a representation language for these arch examples. A semantic network with nodes like "upright block" and "sideways block" and relations like "supports" and "has_part" works:



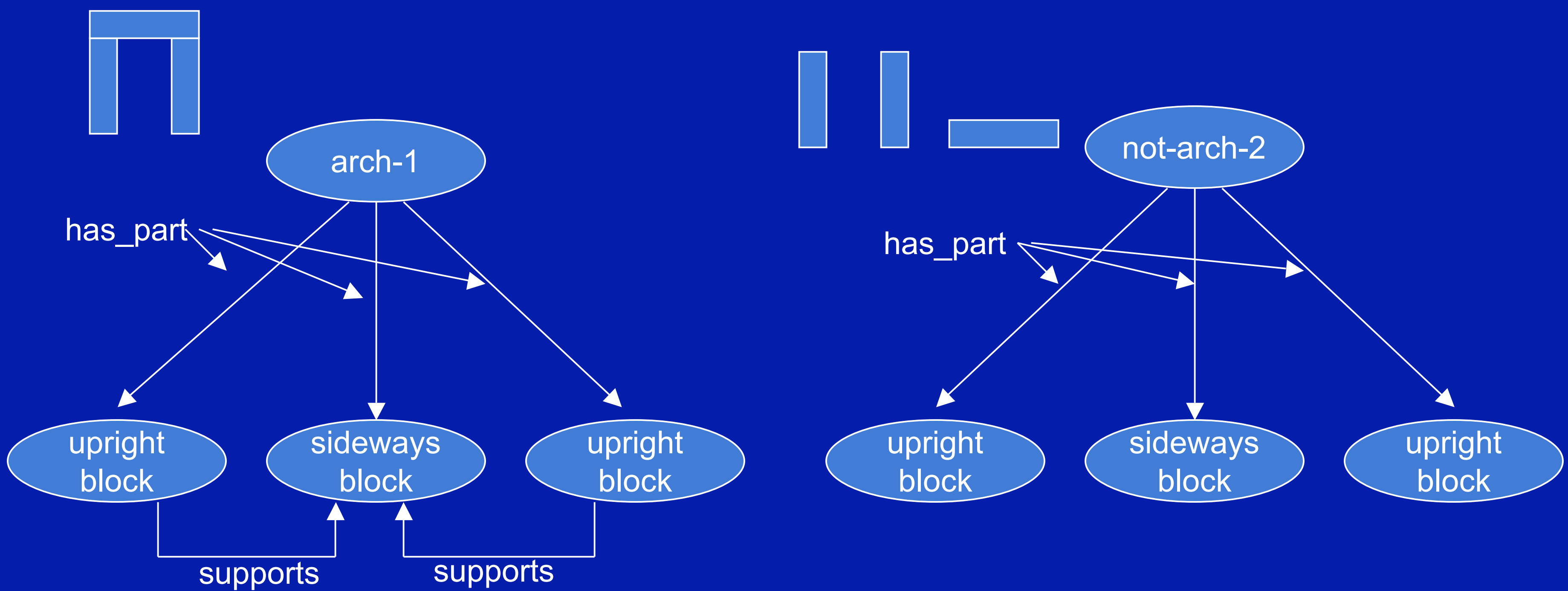
Example: Supervised learning of concept

So let's say our arch-learning program doesn't yet have a concept for arch. We start it off with this semantic net as a positive training example. This is now what it knows about "archness"...its internalized arch concept.



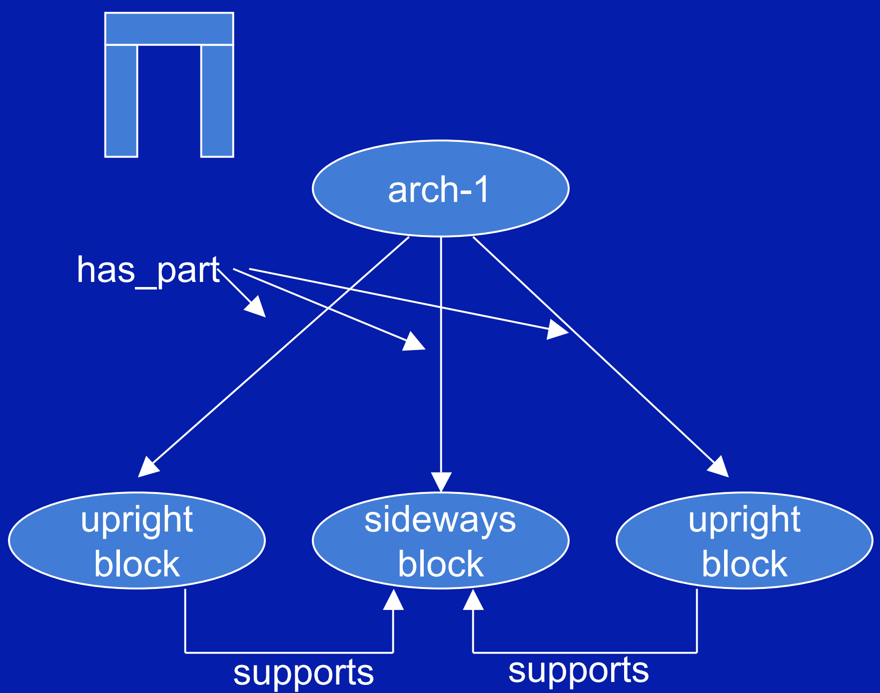
Example: Supervised learning of concept

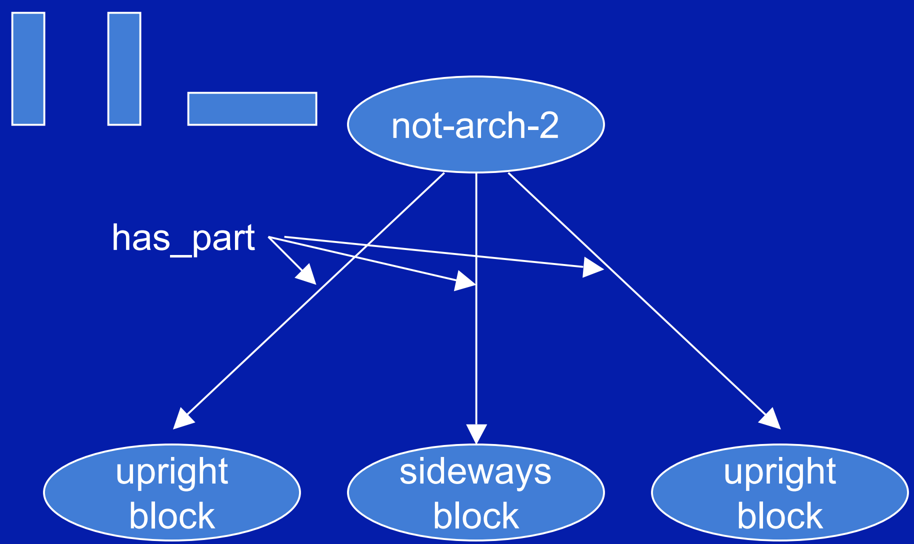
Now we present the program with a negative example or "near miss"...almost an arch, but not quite:



Example: Supervised learning of concept

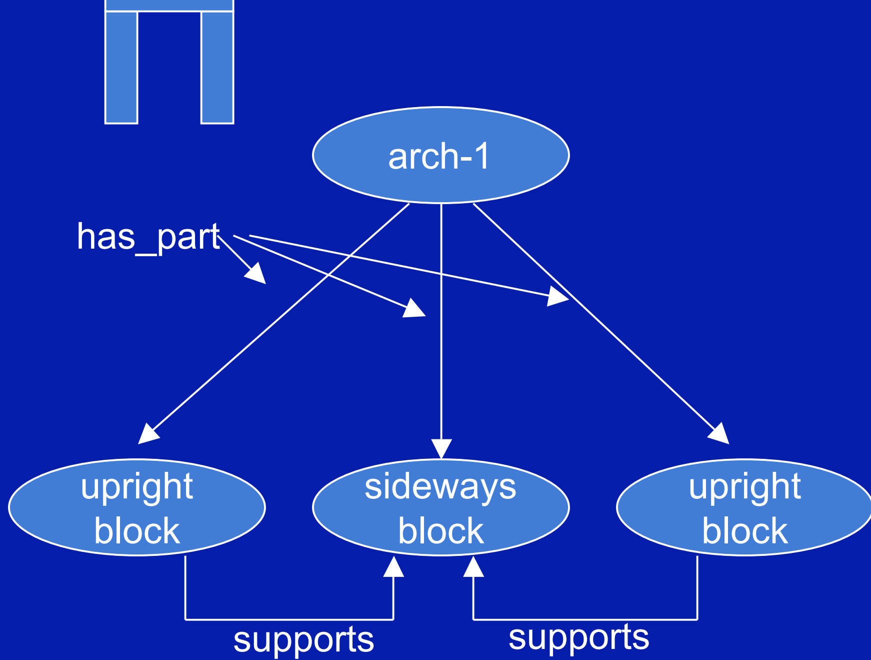
The program must now figure out what the difference is between its arch concept and the near miss. What is it?

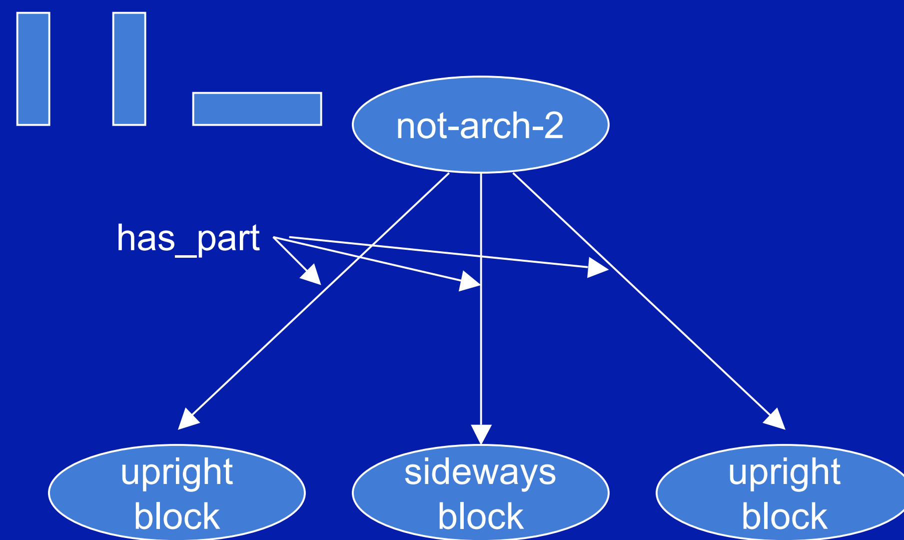




Example: Supervised learning of concept

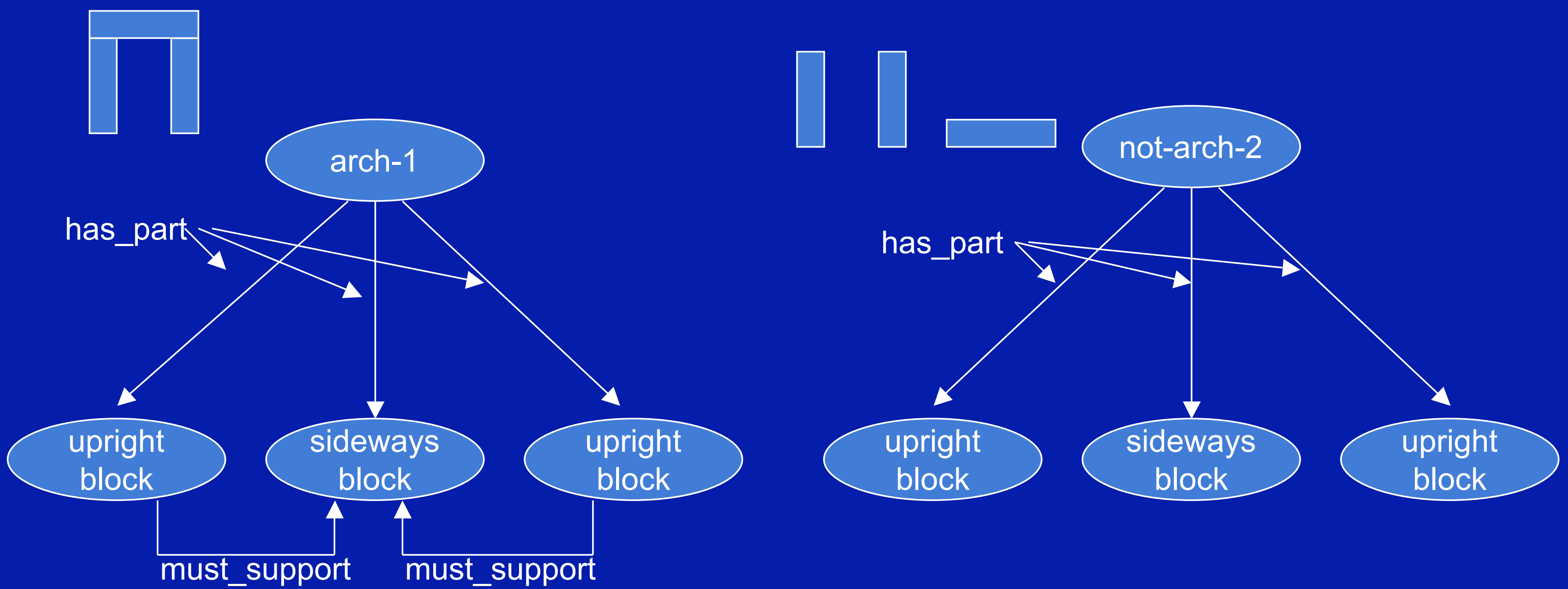
The difference is that the support links are missing in the negative example. Since that's the only difference, the support links must be required. That is, the upright blocks must support the sideways block.





Example: Supervised learning of concept

The program revises its concept of the arch accordingly.



Example: Supervised learning of concept

Negative examples help the learning procedure specialize. If the model of an arch is too general (too inclusive), the negative examples will tell the procedure in what ways to make the model more specific.