CPSC 322
Introduction to Artificial Intelligence

November 24, 2004

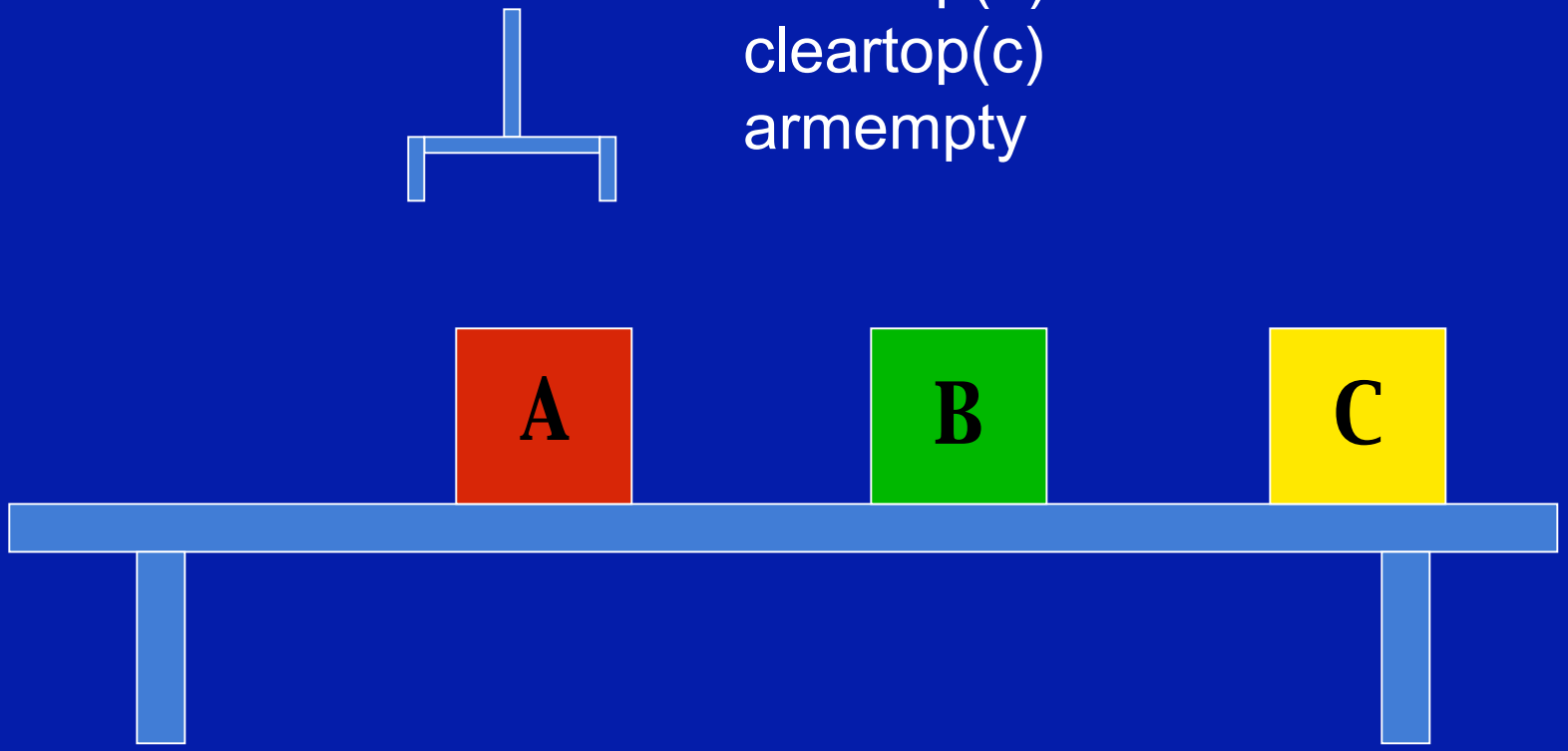
Things...

Term project is due Monday

The final exam will be at noon on Friday, December 10, in MCML 166

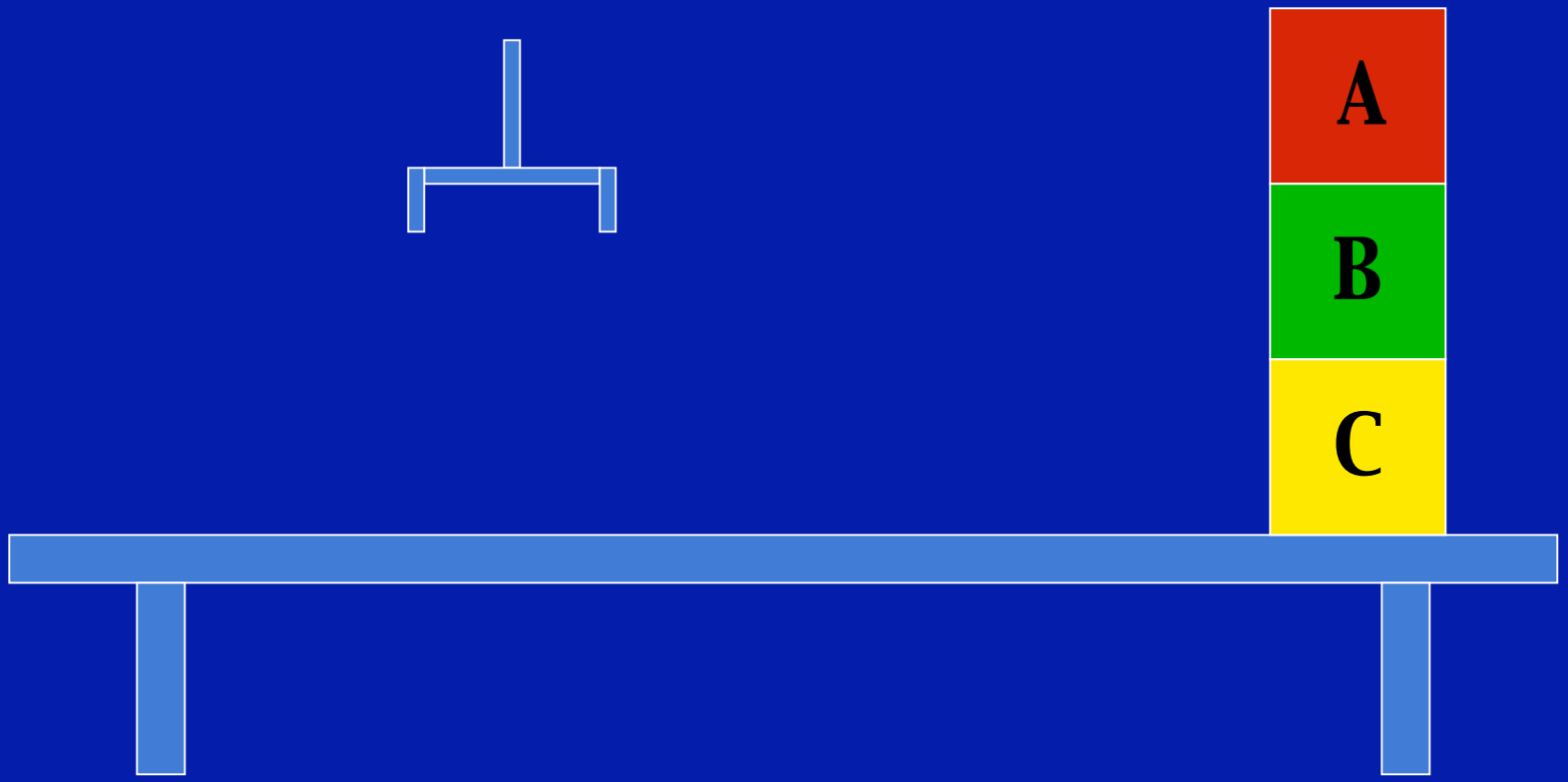
A new start state

ontable(a)
ontable(b)
ontable(c)
cleartop(a)
cleartop(b)
cleartop(c)
armempty



A new goal state

on(a,b)
on(b,c)



Will our simple planner work?

Load ‘strips01.ci’ and add the extra block

Try it on both of these:

```
ask achieve_all([on(b,c),on(a,b)],init,P).
ask achieve_all([on(a,b),on(b,c)],init,P).
```

Why it doesn't work

```
/* the simple STRIPS planner */

remove(X,[X|Y],Y).

achieve_all([],W0,W0).

achieve_all(Goals,W0,W2) <-
     remove(G,Goals,Rem_Gs) &          % choose first goal on list
     achieve(G,W0,W1) &                % try to achieve that goal G
     achieve_all(Rem_Gs,W1,W2).        % then deal with other goals

achieve(G,W,W) <- holds(G,W).          % goal G is achieved if it
                                       % holds for state W

achieve(G,W0,do(Action,W1)) <-
     achieves(Action,G) &              % G on add list for Action
     preconditions(Action,Pre) &       % get preconds for Action
     achieve_all(Pre,W0,W1).           % preconds are now goals
```

You gotta check intermediate states, not just the initial state

Will a more complex planner work?

Load ‘strips02.ci’ -- the extra block is already there

Then try it on both of these:

```
ask achieve_all([on(b,c),on(a,b)],init,P).
ask achieve_all([on(a,b),on(b,c)],init,P).
```

Here's a better planner

```
achieve_all([],W0,W0).
achieve_all(Goals,W0,W2) <-
     remove(G,Goals,Rem_Gs) &
     achieve(G,W0,W1) &
     achieve_all(Rem_Gs,W1,W2).

achieve(G,W,W) <- true_in(G,W).
achieve(A \= B,W,W) <- A \= B.

achieve(G,W0,do(Action,W1)) <-
     achieves(Action,G) &
     preconditions(Action,Pre) &
     achieve_all(Pre,W0,W1).

true_in(G,init) <-
   holds(G,init).
true_in(G,do(A,_)) <-
   achieves(A,G).
true_in(G,do(A,S)) <-
   true_in(G,S) &
   ~ deletes(A,G).
```

Here's a better planner

```
achieve_all([],W0,W0).
achieve_all(Goals,W0,W2) <-
     remove(G,Goals,Rem_Gs) &
     achieve(G,W0,W1) &
     achieve_all(Rem_Gs,W1,W2).

achieve(G,W,W) <- true_in(G,W).
achieve(A \= B,W,W) <- A \= B.        % so we don't stack a block
                                      % on itself
achieve(G,W0,do(Action,W1)) <-
     achieves(Action,G) &
     preconditions(Action,Pre) &
     achieve_all(Pre,W0,W1).

true_in(G,init) <-
   holds(G,init).
true_in(G,do(A,_)) <-
   achieves(A,G).
true_in(G,do(A,S)) <-
   true_in(G,S) &
   ~ deletes(A,G).
```

Here's a better planner

```
achieve_all([],W0,W0).
achieve_all(Goals,W0,W2) <-
     remove(G,Goals,Rem_Gs) &
     achieve(G,W0,W1) &
     achieve_all(Rem_Gs,W1,W2).

achieve(G,W,W) <- true_in(G,W).
achieve(A \= B,W,W) <- A \= B.

achieve(G,W0,do(Action,W1)) <-
     achieves(Action,G) &
     preconditions(Action,Pre) &
     achieve_all(Pre,W0,W1).

true_in(G,init) <-
   holds(G,init).
true_in(G,do(A,_)) <-
   achieves(A,G).
true_in(G,do(A,S)) <-
   true_in(G,S) &
   ~ deletes(A,G).
```

```
% check more than init state
% so we don't stack a block
% on itself
```

Here's a better planner

```
achieve_all([],W0,W0).
achieve_all(Goals,W0,W2) <-
     remove(G,Goals,Rem_Gs) &
     achieve(G,W0,W1) &
     achieve_all(Rem_Gs,W1,W2).

achieve(G,W,W) <- true_in(G,W).          % check more than init state
achieve(A \= B,W,W) <- A \= B.           % so we don't stack a block
                                         % on itself
achieve(G,W0,do(Action,W1)) <-
     achieves(Action,G) &
     preconditions(Action,Pre) &
     achieve_all(Pre,W0,W1).

true_in(G,init) <-                       % G achieved if it holds in
   holds(G,init).                        % initial state
true_in(G,do(A,_)) <-
   achieves(A,G).
true_in(G,do(A,S)) <-
   true_in(G,S) &
   ~ deletes(A,G).
```

Here's a better planner

```
achieve_all([],W0,W0).
achieve_all(Goals,W0,W2) <-
     remove(G,Goals,Rem_Gs) &
     achieve(G,W0,W1) &
     achieve_all(Rem_Gs,W1,W2).

achieve(G,W,W) <- true_in(G,W).          % check more than init state
achieve(A \= B,W,W) <- A \= B.           % so we don't stack a block
                                         % on itself
achieve(G,W0,do(Action,W1)) <-
     achieves(Action,G) &
     preconditions(Action,Pre) &
     achieve_all(Pre,W0,W1).

true_in(G,init) <-                       % G achieved if it holds in
   holds(G,init).                        % initial state
true_in(G,do(A,_)) <-                    % or if it's on the add list
   achieves(A,G).                        % of the action that's the
true_in(G,do(A,S)) <-                    % most recent plan step
   true_in(G,S) &
   ~ deletes(A,G).
```

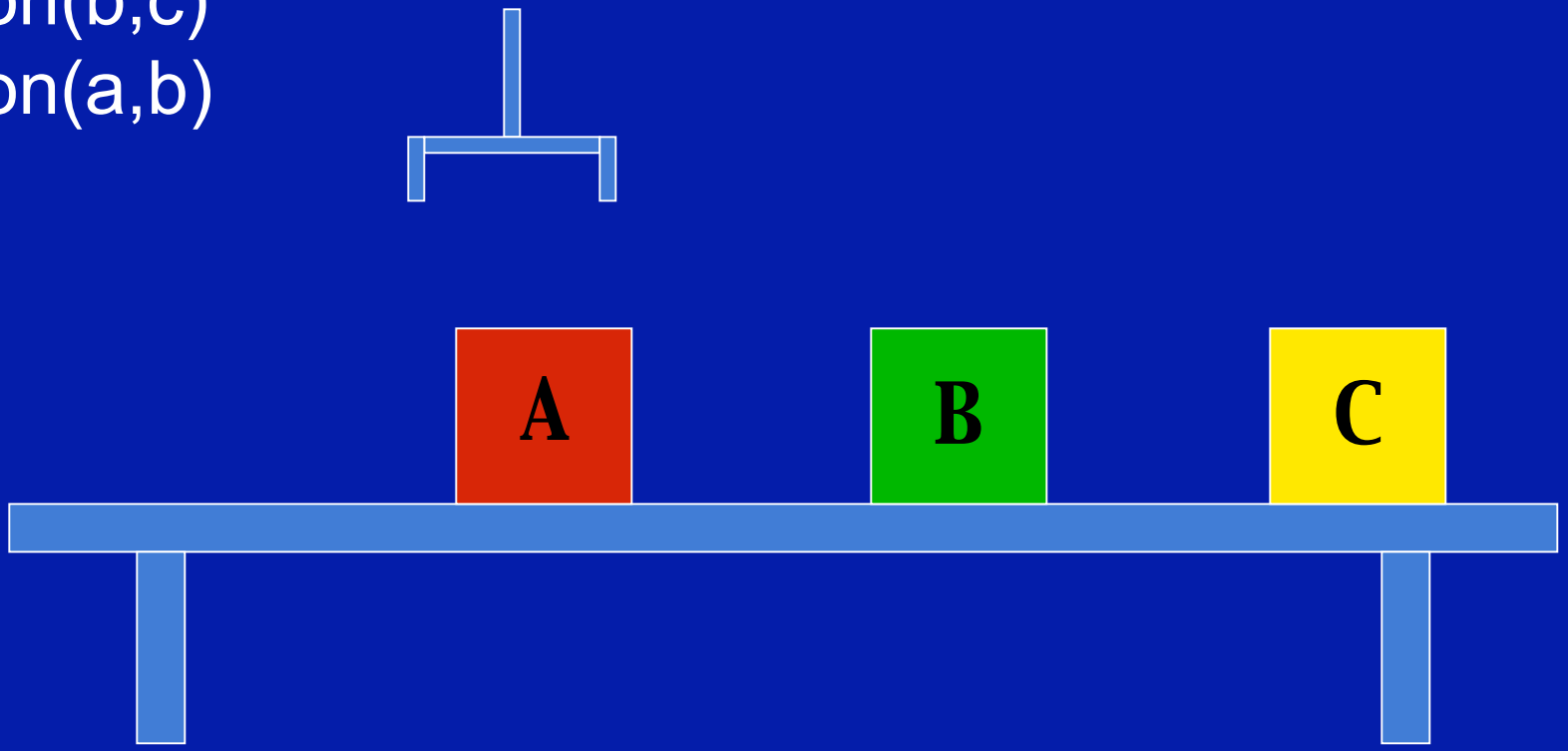
Here's a better planner

```
achieve_all([],W0,W0).
achieve_all(Goals,W0,W2) <-
     remove(G,Goals,Rem_Gs) &
     achieve(G,W0,W1) &
     achieve_all(Rem_Gs,W1,W2).

achieve(G,W,W) <- true_in(G,W).          % check more than init state
achieve(A \= B,W,W) <- A \= B.           % so we don't stack a block
                                         % on itself
achieve(G,W0,do(Action,W1)) <-
     achieves(Action,G) &
     preconditions(Action,Pre) &
     achieve_all(Pre,W0,W1).

true_in(G,init) <-                       % G achieved if it holds in
   holds(G,init).                        % initial state
true_in(G,do(A,_)) <-                    % or if it's on the add list
   achieves(A,G).                        % of the action that's the
true_in(G,do(A,S)) <-                    % most recent plan step
   true_in(G,S) &                        % or if it's achieved in an
   ~ deletes(A,G).                       % earlier plan step and not
                                         % on delete list of A
```

Why doesn't it work always?

goals:

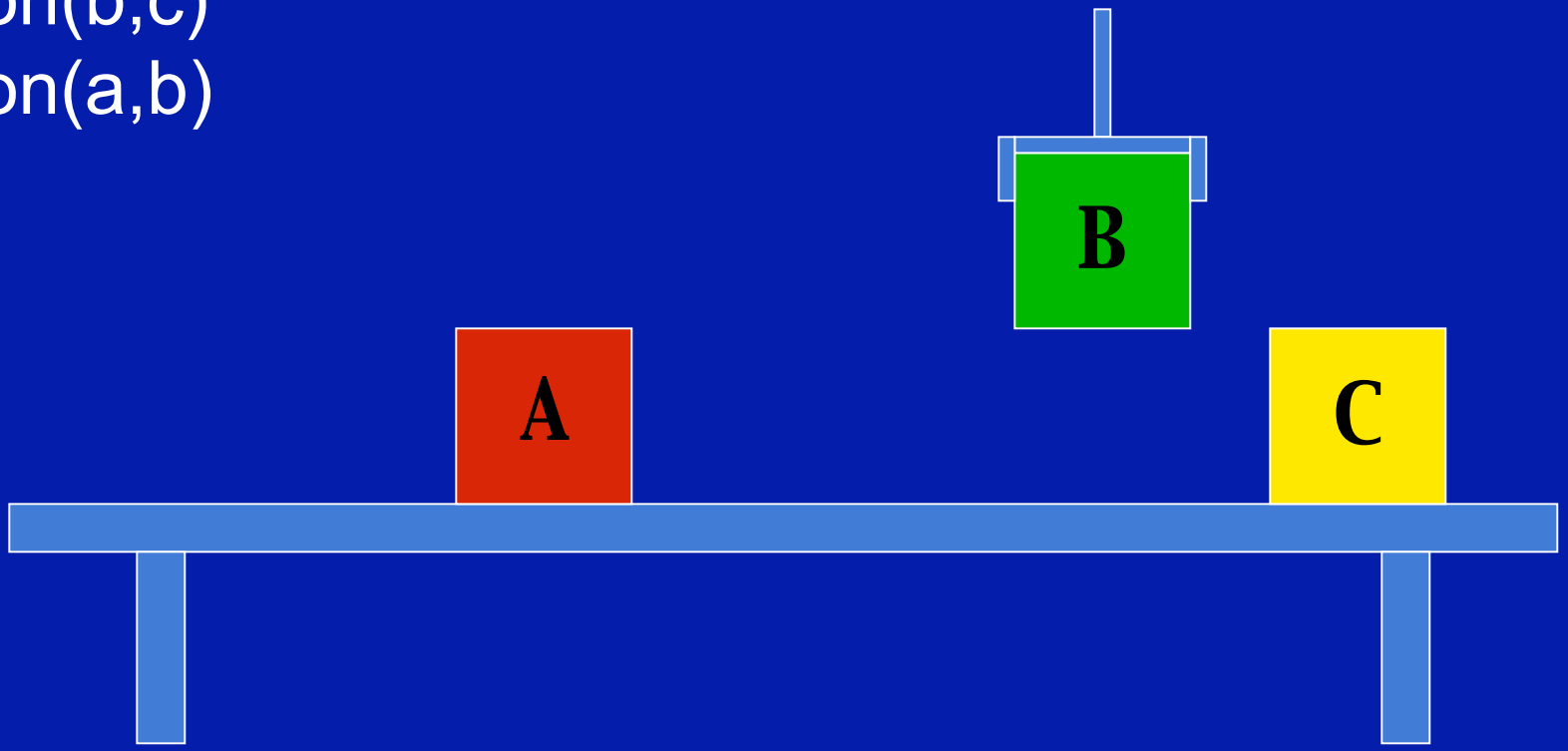
on(b,c)
on(a,b)



Why doesn't it work always?

goals:

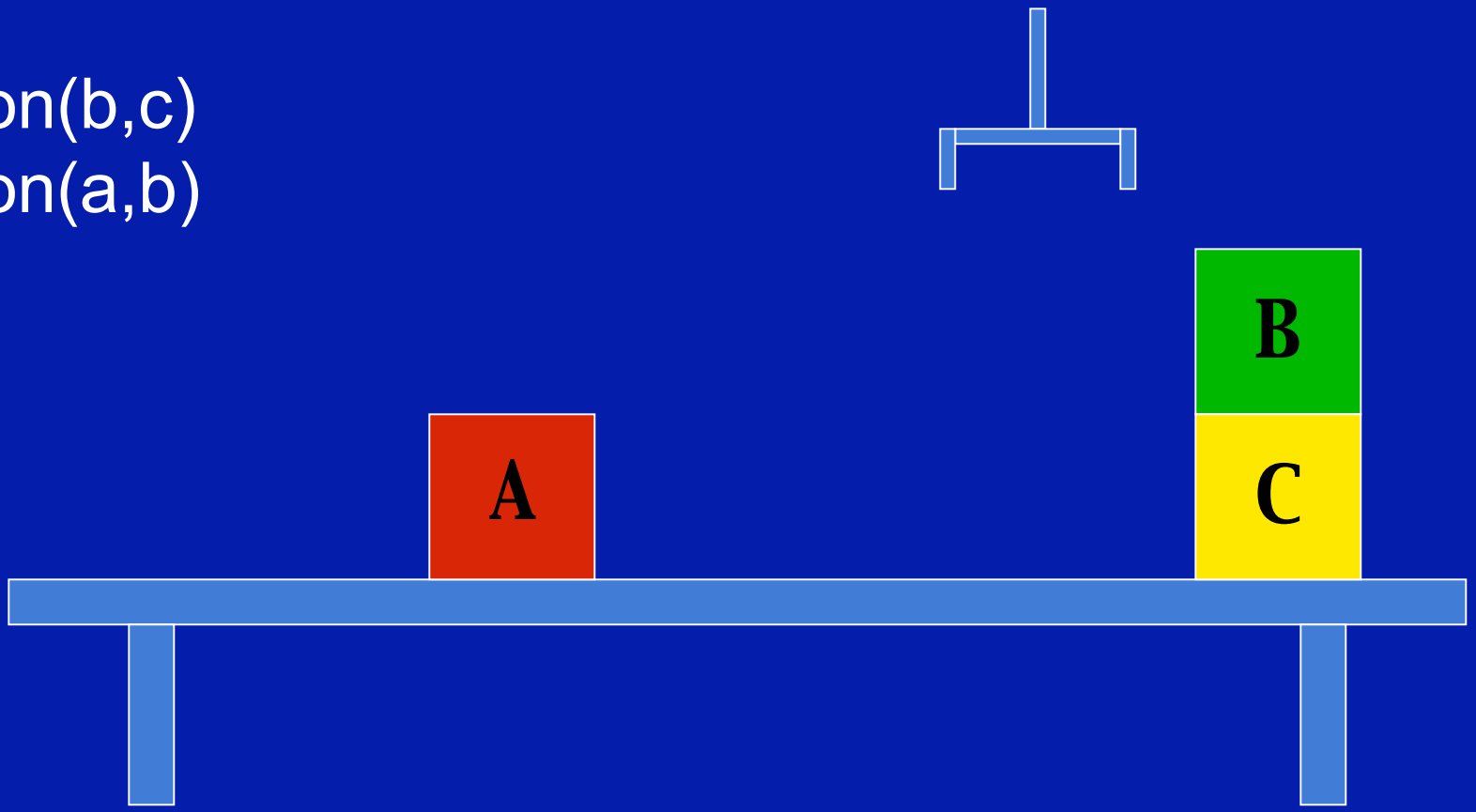
on(b,c)
on(a,b)



Why doesn't it work always?

goals:

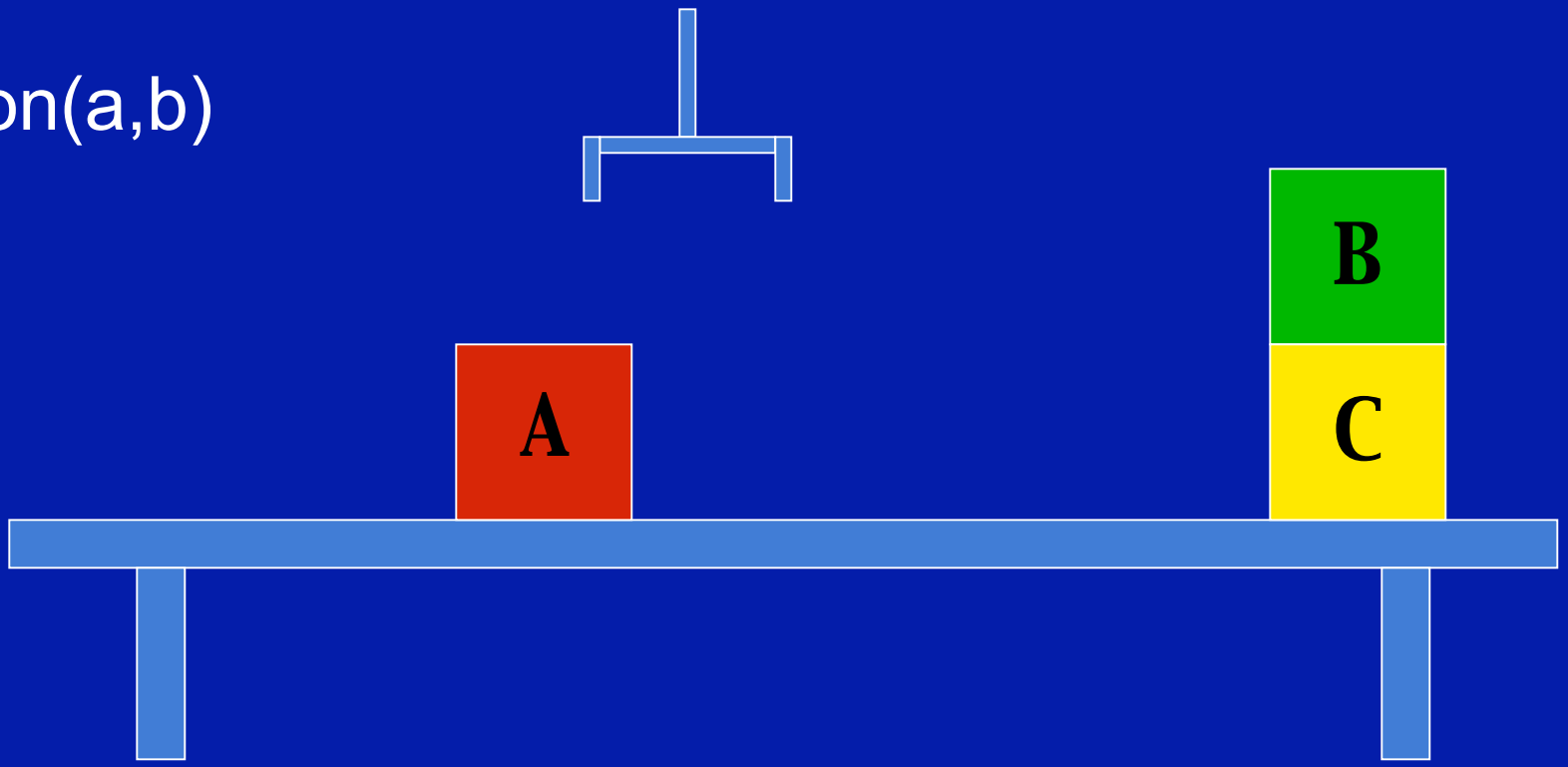
on(b,c)
on(a,b)



Why doesn’t it work always?

goals:

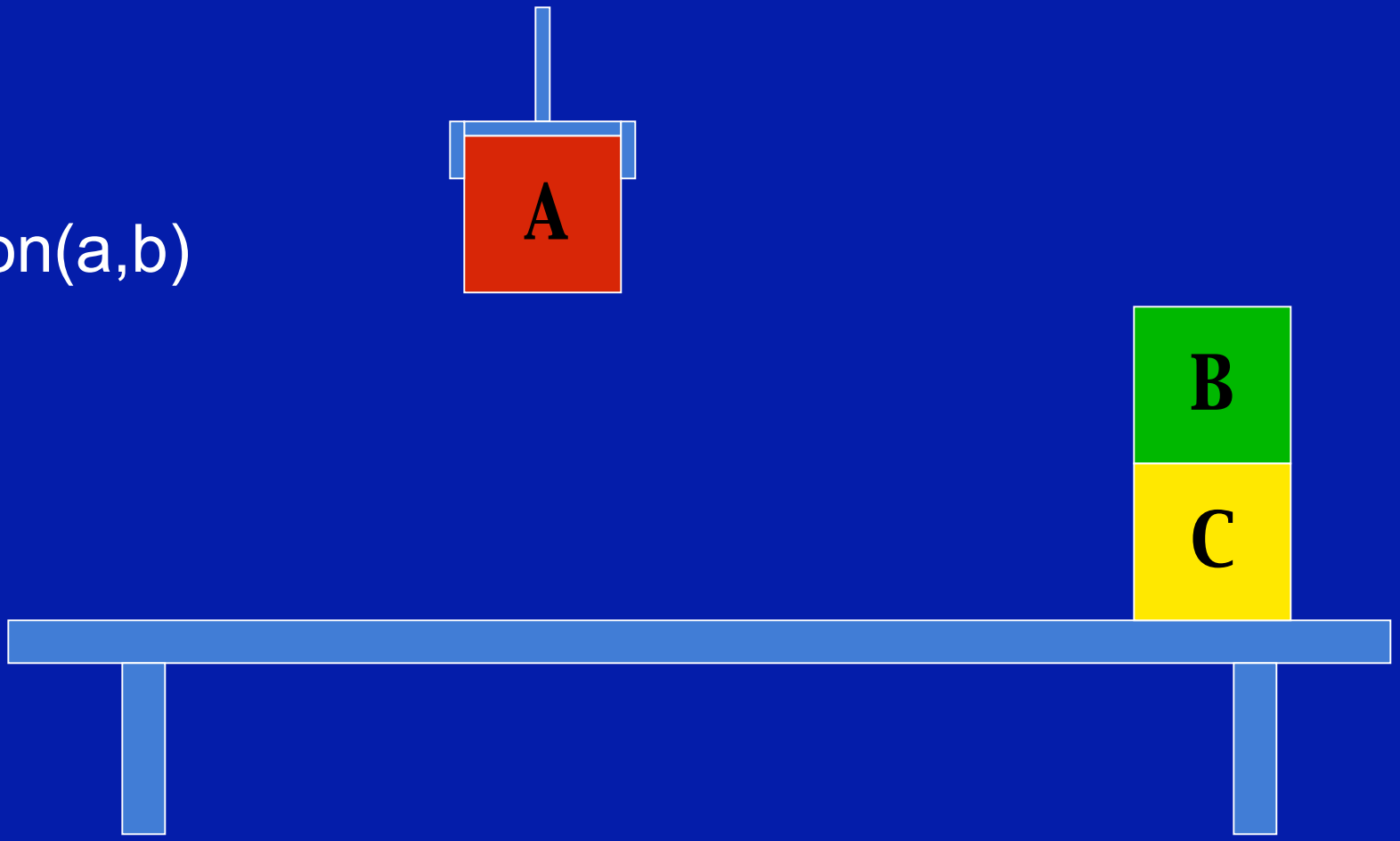
on(a,b)



Why doesn't it work always?

goals:

on(a,b)



Why doesn’t it work always?

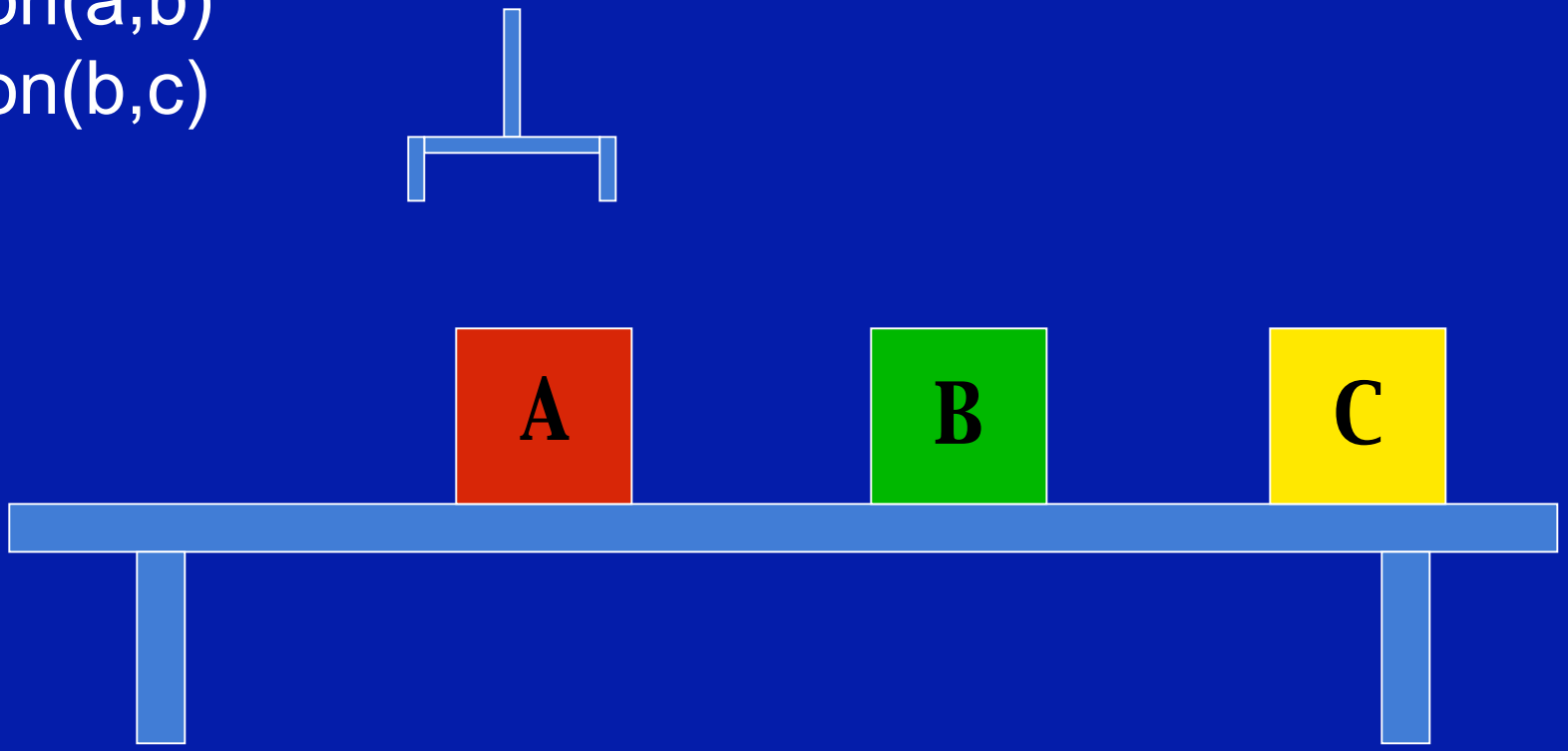
goals:

this works

Why doesn't it work always?

goals:

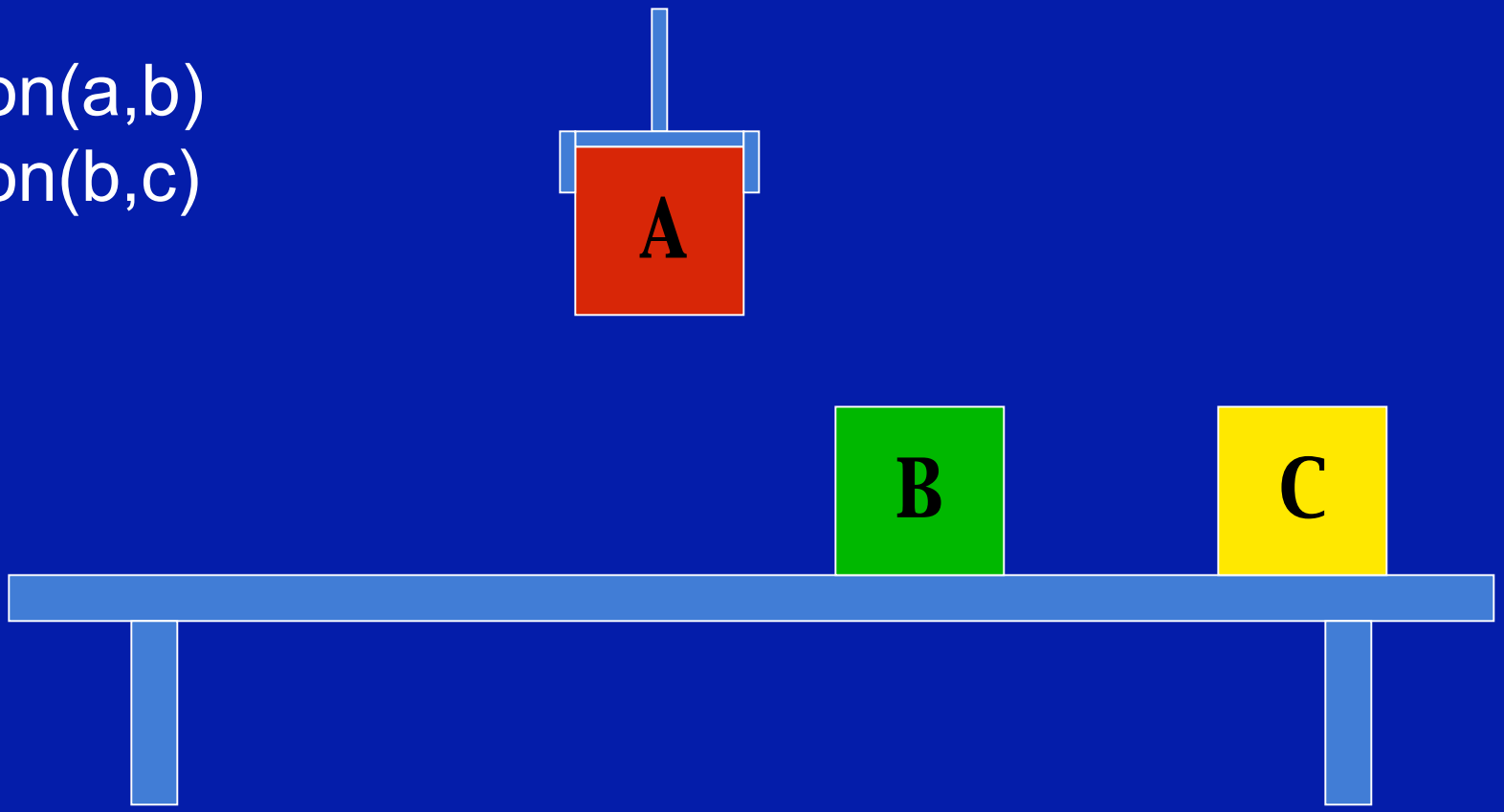
on(a,b)
on(b,c)



Why doesn't it work always?

goals:

on(a,b)
on(b,c)

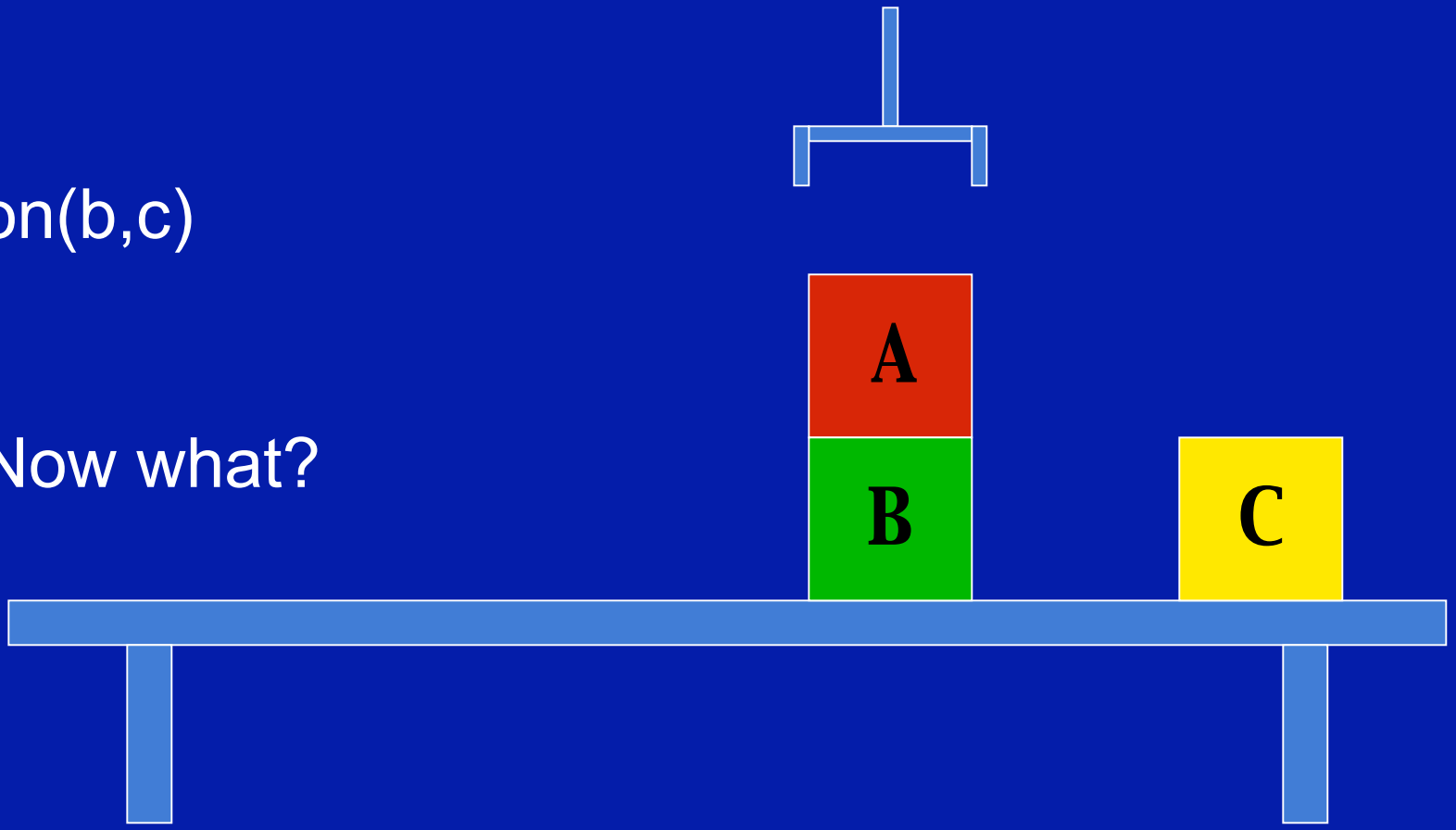


Why doesn't it work always?

goals:

on(b,c)

Now what?

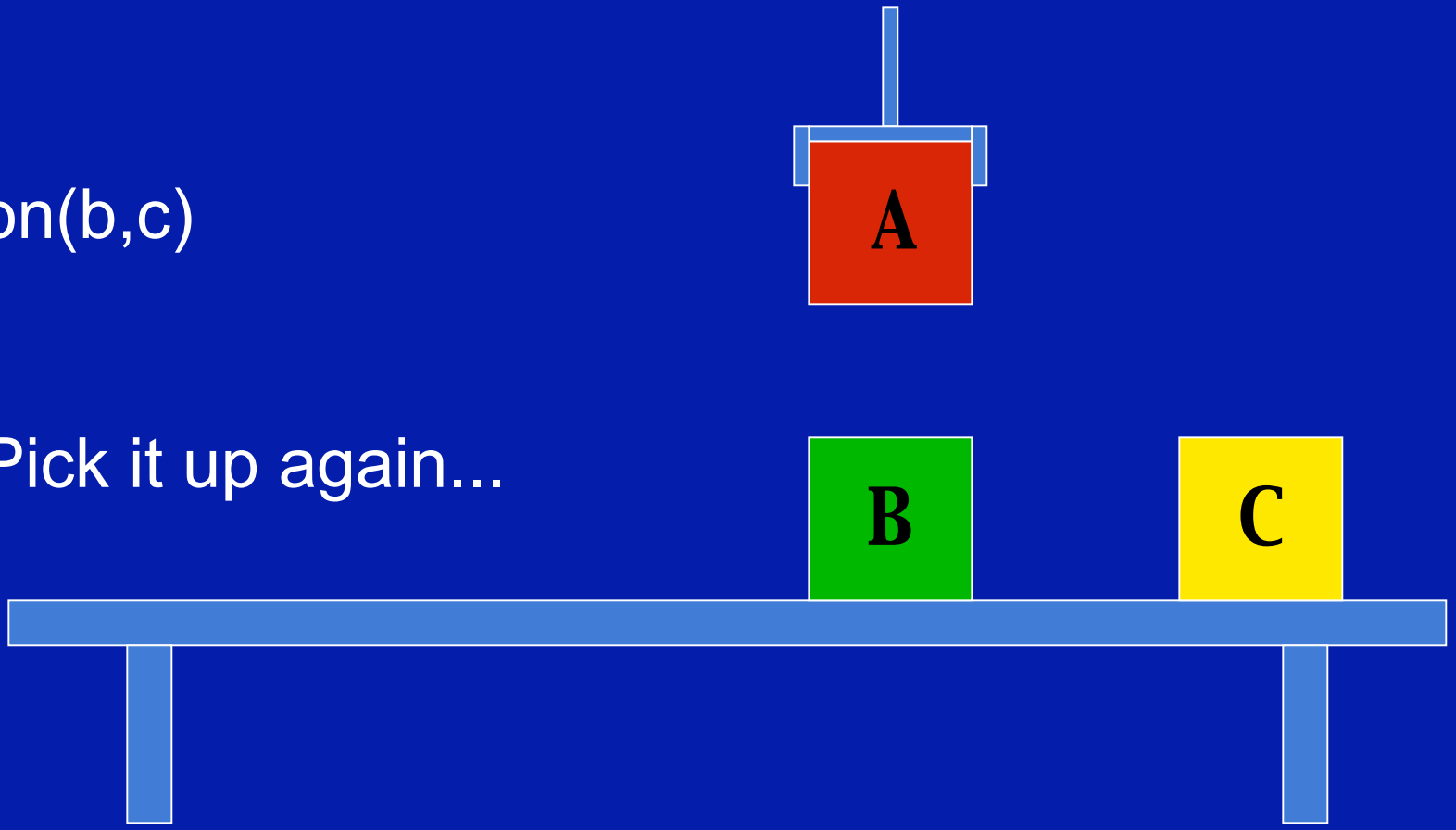


Why doesn't it work always?

goals:

on(b,c)

Pick it up again...

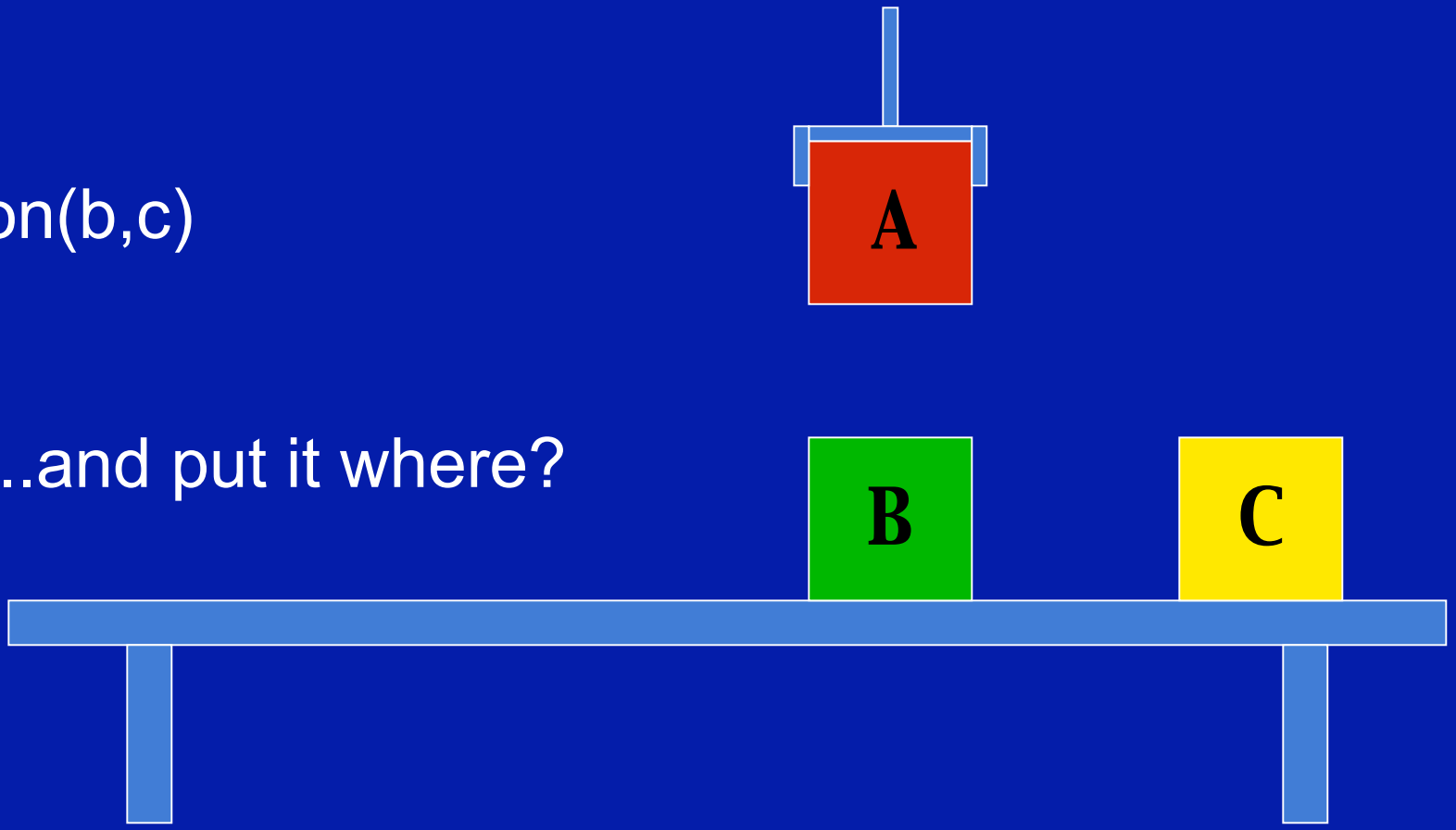


Why doesn't it work always?

goals:

on(b,c)

...and put it where?



Why doesn't it work always?

goals:

on(b,c)