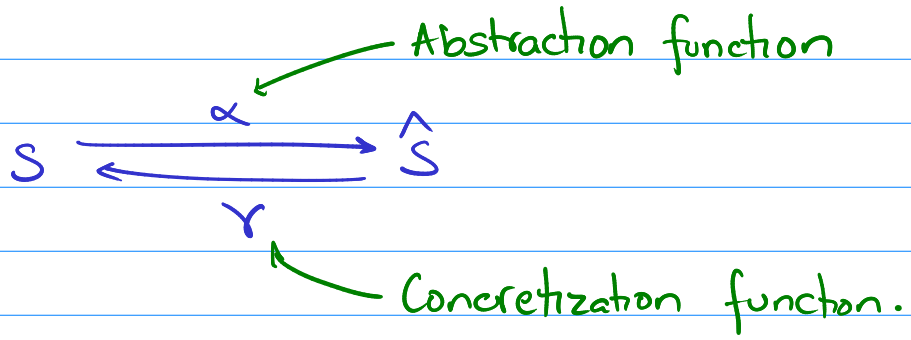
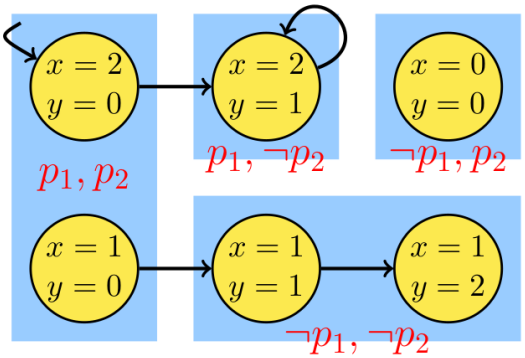
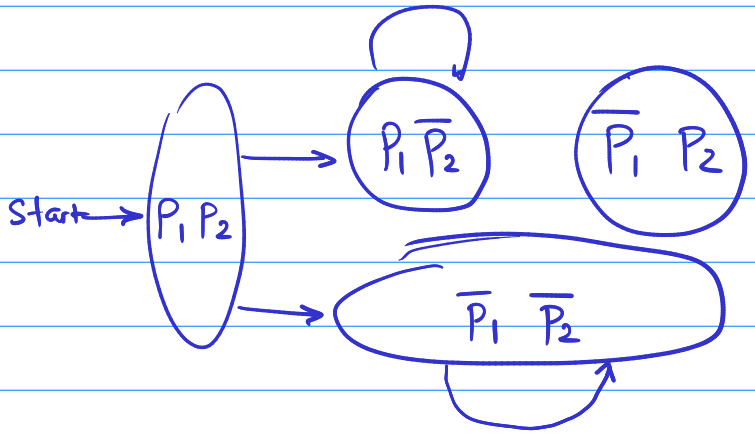
# Lecture 24: Predicate Abstraction, contd




$$\forall q \in S \quad q \in \gamma(\alpha(q))$$



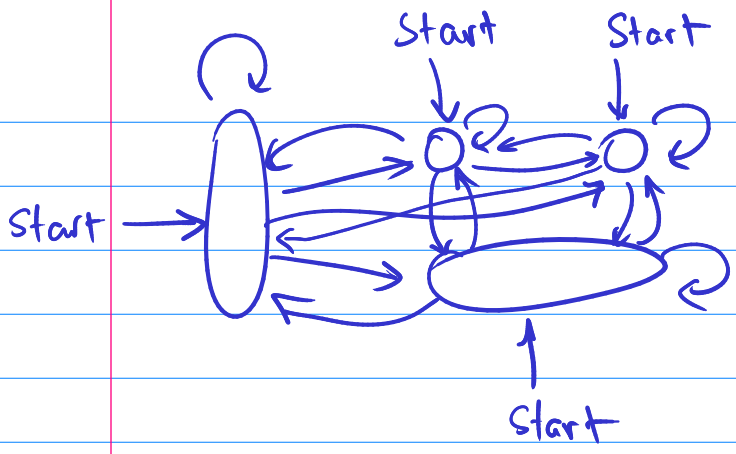

## How to construct abstract system (Conceptually)

- Declare $\hat{q}$ to be a start state

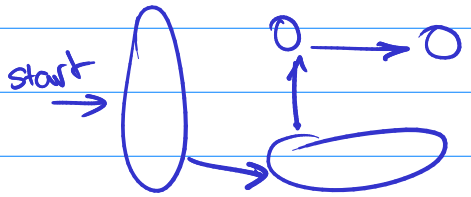
  if $\exists q \in \gamma(\hat{q})$ s.t. $q$ is a start state

- For each pair of abstract states $\hat{q}$ $\hat{q}'$

  draw $\hat{q} \to \hat{q}'$ if $\exists q \in \gamma(\hat{q})$ $q' \in \gamma(\hat{q}')$ s.t. $q \to q'$




Still an existential abstraction




Not an existential abstraction
We should have included
a $p_1 p_2 \to p_1 \overline{p_2}$ transition.

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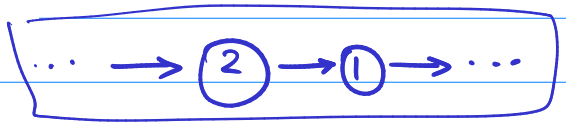
Ex

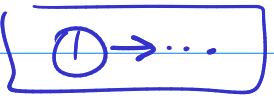
```
do {
① KeAcquireSpinLock();
   nPacketsOld = nPackets;
   if (request) {
      request = request->Next;
   ② KeReleaseSpinLock();
      nPackets++;
   }
} while(nPackets != nPacketsOld);

③ KeReleaseSpinLock();
```

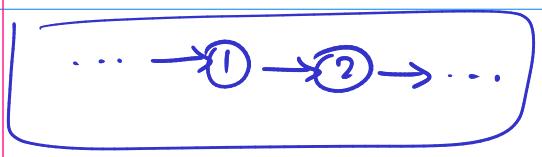
Observation: If it enters the conditional block, then the loop will execute at least one more time.

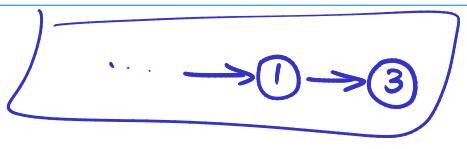



Question: Can we ever see the pattern ... → 1 → 1 → ...

Ans: No. If ① is executed, then it is followed either by ② or by ③



Question:- Let b be the truth value of the predicate np == npo

- Say that b is false.
- Say we now execute np := np+1
- What is the value of b now?
- Can b be true now?

Yes! Consider the case when, originally, np == npo - 1

- Can b be false now?

Yes! Consider the case when, originally

npo == np - 2

Then, now, npo == np - 3

Question: We have a bit b which is tracking the truth value of $np == npo$.

What happens to b when we execute $np := np+1$?

Answer: Case 1: b was false before.

Then b can either be true or false after. Depends on information we don't have.

Case 2: b was true before.

Then, b has to be false after.

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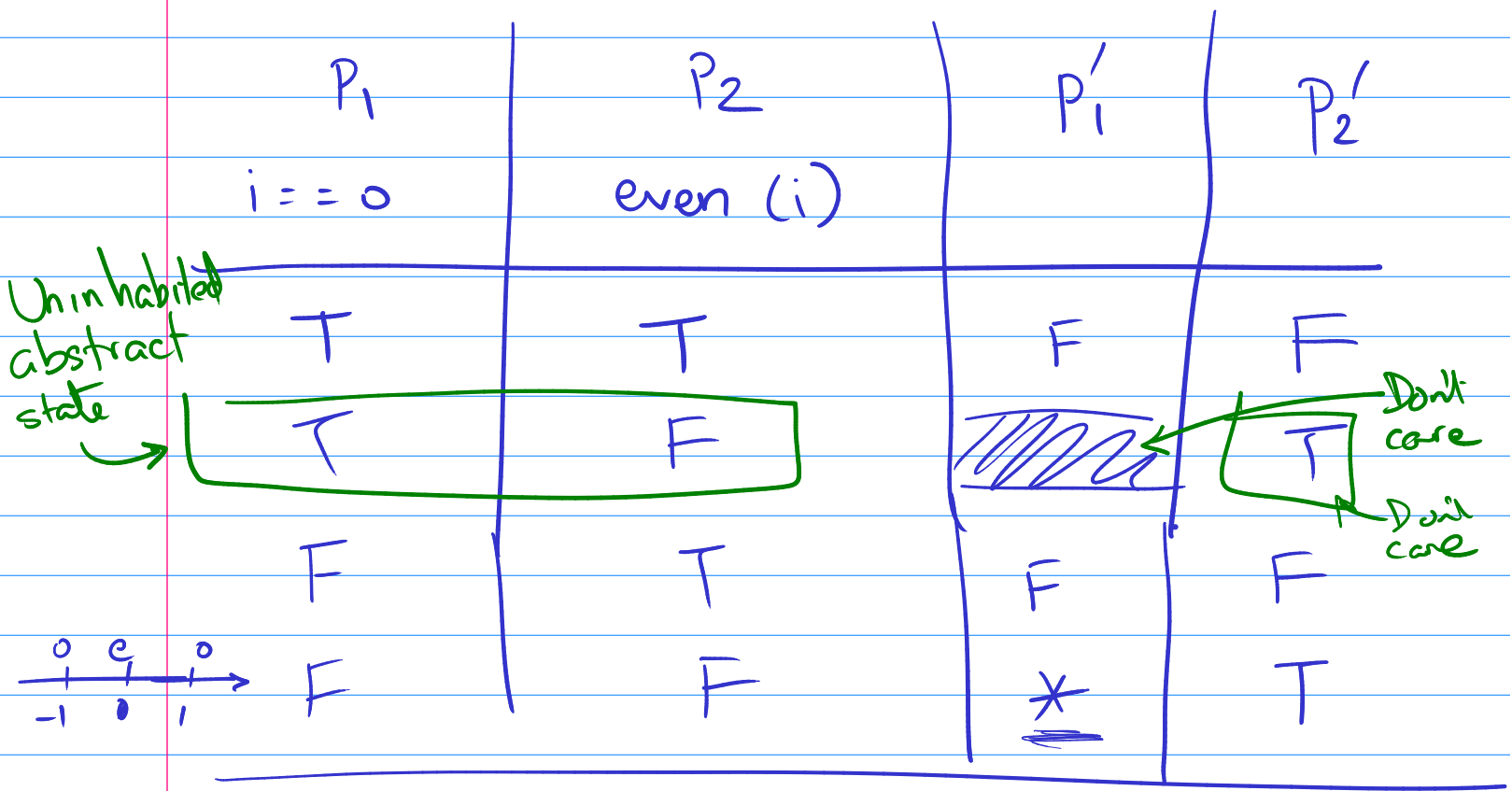
Therefore: We can abstract the update $np := np+1$ as $b := \text{if } (b) \text{ then false else } *$

**Question** :- The bit $p_1$ tracks the value of the predicate $i == 0$

- The bit $p_2$ tracks the value of the predicate even $(i)$

- What is the effect of the assignment $i := i+1$ on the values of $p_1$ & $p_2$?




$i := i+1 \Rightarrow$

$p_1 := p_1 \vee p_2 \;?\; F : *$

$p_2 := \neg p_2$

$p_1 \;?\; F : (p_2 : F : *)$